SPERRY CORPORATION
AEROSPACE & MARINE GROUP
PHOENIX, ARIZONA

Type ADT-222B
Air Data Test System
Part No. 4047505-XXX

Ground Equipment Manual

Volume I of II

PRINTED IN U.S.A.

PUB. NO. 31-4322-03

REVISED 1 JULY 1982
1 NOVEMBER 1981

Honeywell

NOTICE

Products and components identified with the name Sperry are products and components of Honeywell Inc., Sperry Commercial Flight Systems Division, Phoenix, Arizona.

LIST OF EFFECTIVE PAGES FOR VOLUME I

SUBJECT	PAGE	DATE
Title		Jul 1/82
List of Effective Pages		
	1	Jul 1/82
	2	Jul 1/82
	3	Nov 1/81
	4 Blank	Nov 1/81
Record of Revisions		Nov 1/81
List of Illustrations		Nov 1/81
List of Tables		
	1	Nov 1/81
	2	Nov 1/81
Safety Notice		Nov 1/81
Foreword		
	1	Nov 1/81
	2	Nov 1/81
GENERAL INFORMATION AND OPERATING INSTRUCTIONS	1-0	Nov 1/81
Contents	1-0	Nov 1/81
Description	1-1	
	1	Nov 1/81
	2	Nov 1/81
	3	Nov 1/81
	4	Nov 1/81
	5	Nov 1/81
	6	Nov 1/81
	7	Nov 1/81
	8 Blank	Nov 1/81
Operating Instructions	1-2	
	1	Nov 1/81
	2	Nov 1/81
	3	Nov 1/81
	4	Nov 1/81
	5	Nov 1/81
	6	Nov 1/81
	7	Nov 1/81
	8	Nov 1/81
	9	Nov 1/81
	10	Nov 1/81
	11	Nov 1/81
	12	Nov 1/81
	13	Nov 1/81
	14	Nov 1/81
	15	Nov 1/81
	16	Nov 1/81
	17	Nov 1/81
	18	Nov 1/81
	19	Nov 1/81
	20 Blank	Nov 1/81
Specifications	1-3	
	1	Nov 1/81
	2	Nov 1/81
	3	Nov 1/81
	4	Nov 1/81
	5	Nov 1/81
	6	Nov 1/81
	7	Nov 1/81
	8	Nov 1/81
	9	Nov 1/81
	10	Nov 1/81
	11	Nov 1/81
	12	Nov 1/81
	13	Nov 1/81
	14	Nov 1/81
	15	Nov 1/81
	16	Nov 1/81
	17	Nov 1/81

This manual was released for distribution July 20/82.

SUBJECT	PAGE	DATE
Specifications (cont)	1-3	
	18	Nov 1/81
	19	Nov 1/81
	20	Nov 1/81
	21	Nov 1/81
	22	Nov 1/81
INSTALLATION AND REMOVAL	2-0	Nov 1/81
Contents	2-0	Nov 1/81
Handling and Mounting	2-1	
	1	Nov 1/81
	2 Blank	Nov 1/81
Equipment and Materials	2-2	
	1	Nov 1/81
	2	Jul 1/82
	3	Nov 1/81
	4	Nov 1/81
	5	Nov 1/81
	6	Nov 1/81
Installation Procedure	2-3	
	1	Nov 1/81
	2	Nov 1/81
	3	Nov 1/81
	4 Blank	Nov 1/81
Installation Verification	2-4	
	1	Nov 1/81
	2	Nov 1/81
	3	Nov 1/81
	4	Nov 1/81
Removal from Service	2-5	
	1	Nov 1/81
	2 Blank	Nov 1/81
Storage and Shipping	2-6	
	1	Nov 1/81
	2	Nov 1/81
	3	Nov 1/81
	4 Blank	Nov 1/81
AUTOMATIC OPERATION	3-0	Nov 1/81
Contents	3-0	Nov 1/81
Description	3-1	
	1	Nov 1/81
	2	Nov 1/81
	3	Nov 1/81
	4 Blank	Nov 1/81
Operating Procedures	3-2	
	1	Nov 1/81
	2	Nov 1/81
Installation/ Checkout	3-3	
	1	Nov 1/81
	2	Nov 1/81
	3	Nov 1/81
	4	Nov 1/81
	5	Nov 1/81
	6	Nov 1/81
	7	Nov 1/81
	8	Nov 1/81
	9	Nov 1/81
	10	Nov 1/81
	11	Nov 1/81
	12 Blank	Nov 1/81
Programming Instructions	3-4	
	1	Nov 1/81
	2	Nov 1/81
	3	Nov 1/81
	4	Nov 1/81
	5	Nov 1/81
	6	Nov 1/81
	7	Nov 1/81
	8	Nov 1/81
	9	Nov 1/81
	10	Nov 1/81
	11	Nov 1/81
	12	Nov 1/81

SUBJECT	PAGE	DATE
Programming Instructions (cont)	3-4	
	13	Nov 1/81
	14	Nov 1/81
	15	Nov 1/81
	16	Nov 1/81
	17	Nov 1/81
	18	Nov 1/81
	19	Nov 1/81
	20	Nov 1/81
	21	Nov 1/81
	22	Nov 1/81
	23	Nov 1/81
	24	Nov 1/81
Maintenance	3-5	
	1	Nov 1/81
	2 Blank	Nov 1/81
	3	Nov 1/81
	4 Blank	Nov 1/81
	5	Nov 1/81
	6 Blank	Nov 1/81
	7	Nov 1/81
	8 Blank	Nov 1/81
	9	Nov 1/81
	10 Blank	Nov 1/81
	11	Nov 1/81
	12 Blank	Nov 1/81
	13	Nov 1/81
	14 Blank	Nov 1/81
	15	Nov 1/81
	16 Blank	Nov 1/81
	17	Nov 1/81
	18 Blank	Nov 1/81
	19	Nov 1/81
	20 Blank	Nov 1/81
	21	Nov 1/81
	22 Blank	Nov 1/81

Digitized by the Internet Archive
in 2026

https://archive.org/details/manualsplus_12376

RECORD OF REVISIONS FOR VOLUME I

Retain this record in front of manual. On receipt of revision, insert revised pages in the manual, and enter revision number, date inserted, and initial.

Revision Number	Revision Date	Insertion Date	By	Revision Number	Revision Date	Insertion Date	By
1	Jul 1/82	Jul 20/82	S				

LIST OF ILLUSTRATIONS FOR VOLUME I

Figure No.	Title	Chapter/Section	Page
1-1	ADT-222B Air Data Test System	1-1	1
1-2	Front Panel of ADT-222B	1-1	3
1-3	Rear Panel of ADT-222B	1-1	5
1-4	Pneumatic Diagram	1-1	7
1-5	Relationship of P_S to H	1-2	1
1-6	Relationship of Q_C to V_C	1-2	3
1-7	Mach Number (M) vs Pressure Ratio	1-2	3
1-8	Mach Number vs Pressure Altitude and Airspeed	1-2	4
1-9	Front Panel of ADT-222B	1-2	5
2-1	Oil Trap Fabrication Layout	2-2	4
2-2	Typical Oil Trap Interface	2-2	5
2-3	Power Connection Schematic	2-3	2
2-4	Pneumatic Connection Schematic	2-3	3
2-5	ADT-222B Storage and Shipping Container	2-6	2
3-1	ASCII Interface Card Block Diagram	3-1	3
3-2	ATE Mating Connector (J4 Rear Panel)	3-3	2
3-3	ATE IEEE-488 Mating Connector (J3 Rear Panel)	3-3	5
3-4	Functional Transitions	3-3	7
3-5	Address Selector Switch Location	3-4	1
3-6	ASCII Interface Card A10 Schematic	3-5	3

LIST OF TABLES FOR VOLUME I

Table No.	Title	Chapter/Section	Page
1-1	Front Panel Controls, Connectors, and Functions	1-2	6
1-2	Rear Panel Controls, Connectors, and Functions	1-2	9
1-3	Leak Test Commands	1-2	16
1-4	Leading Particulars	1-3	1
1-5	Connections and Fittings	1-3	2
1-6	Operating Range	1-3	3
1-7	UUT Protection Limit Ranges	1-3	5
1-8	Resolution	1-3	6
1-9	Accuracy and Repeatability	1-3	7
1-10	Control Stability	1-3	8
1-11	Performance Specification	1-3	9
3-1	Rear Panel ATE Connector J4 Wiring	3-3	3
3-2	Rear Panel ATE Connector J3 Wiring	3-3	6
3-3	Conversation No. 1	3-3	8
3-4	Conversation No. 2	3-3	11
3-5	ASCII Bus Word Formats	3-4	4
3-6	Data Input Formats (ATE → ADT)	3-4	5
3-7	Data Output Formats (ADT → ATE)	3-4	7
3-8	Input Command Dictionary	3-4	9
3-9	Output Data and Status Dictionary	3-4	12

Table No.	Title	Chapter/Section	Page
3-10	STPX Control Status	3-4	13
3-11	Programmable Protection Limits	3-4	14
3-12	Interface Bus Digit Coding Format	3-4	15
3-13	Sample Conversation	3-4	16
3-14	DATA WORD Information	3-4	22

SAFETY NOTICE

Sperry has a Product Safety Analysis procedure to ensure that equipment designed by Sperry will not create a hazardous condition. As a result of the Product Safety analysis, certain tests and assembly steps have been designated PRODUCTION CRITICAL or INSTALLATION CRITICAL, and 100-percent compliance with those tests and steps is required.

PRODUCTION CRITICAL is defined as:

> Specific methods of fabrication, assembly, inspection and/or test that are required so that it is extremely improbable that the assembly or part will fail.

INSTALLATION CRITICAL is defined as:

> Specific methods of installation are required to assure that either the failure of the assembly or part is extremely improbable or that its failure could not create a hazardous condition.

The procedures covering these critical areas are located in Chapter 2, section 3, paragraph 4, and Chapter 4, section 1.

FOREWORD

This manual provides operation and servicing instructions for Air Data Test System ADT-222B, Part No. 4047505-XXX, manufactured by Sperry Flight Systems, Commercial Division, Phoenix, AZ. Information on the ADT-222B is presented in two separate volumes:

VOLUME I

Chapter 1 General Information and Operating Instructions

Chapter 2 Installation and Removal

Chapter 3 Automatic Operation

VOLUME II

Chapter 4 Maintenance

Chapter 5 Illustrated Parts List

The following table is provided as a definition of ADT-222B configurations:

Dash No.	Calibration Medium	Pneumatic Port Location	Nominal AC Voltage Req'd	Possible Options
-211	Air	Front	115	None
-212	Air	Front	230	None
-213	N_2	Front	115	None
-214	N_2	Front	230	None
-221	Air	Front	115	ASCII
-222	Air	Front	230	ASCII
-223	N_2	Front	115	ASCII
-224	N_2	Front	230	ASCII
-411	Air	Rear	115	None
-412	Air	Rear	230	None
-413	N_2	Rear	115	None
-414	N_2	Rear	230	None
-421	Air	Rear	115	ASCII
-422	Air	Rear	230	ASCII
-423	N_2	Rear	115	ASCII
-424	N_2	Rear	230	ASCII

It is recommended that the operator read and familiarize himself with Chapters 1 and 2 before attempting to install or operate the ADT-222B.

The technical instructions contained in this manual have been validated by actual performance, witnessing of actual performance, or simulation of performance, to the extent necessary to provide reasonable assurance or proof of their accuracy and sufficiency.

CHAPTER 1
GENERAL INFORMATION AND OPERATING INSTRUCTIONS

CHAPTER 1
GENERAL INFORMATION AND OPERATING INSTRUCTIONS

Table of Contents

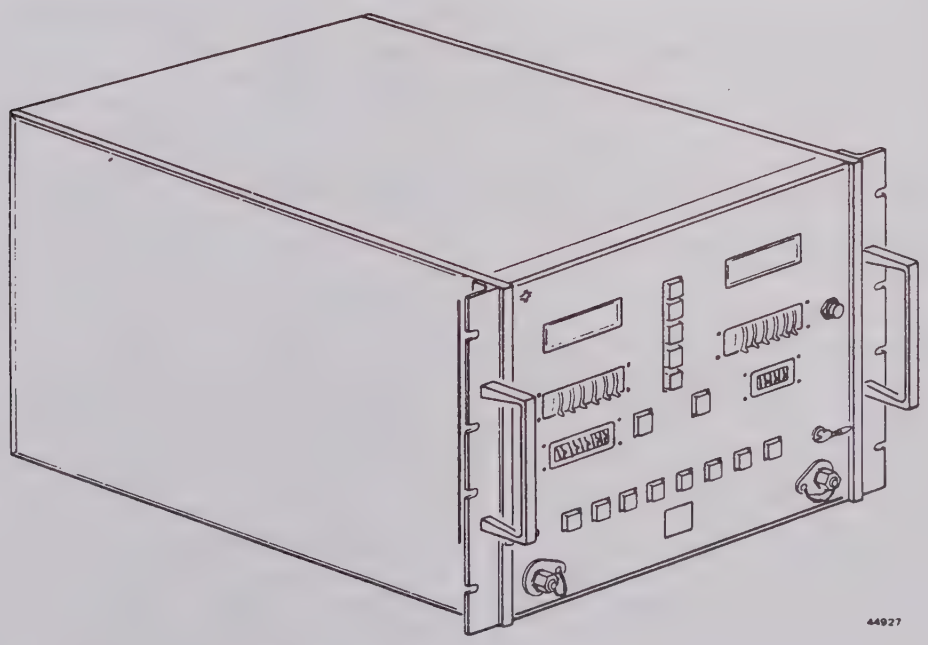
Chapter-Section	Subject	Page
1-1	DESCRIPTION	
	1. General Description	1
	2. Physical Description	2
	3. Functional Description	6
1-2	OPERATING INSTRUCTIONS	
	1. General	1
	2. System Initialization	9
	3. Measure Mode Operation	11
	4. Control Mode Operation	11
	5. Leak Test Operation	15
	6. Dynamic Operation	17
	7. Failure Procedures	17
	8. Error Messages	19
1-3	SPECIFICATIONS	
	1. Leading Particulars	1
	2. Connections and Fittings	2
	3. Range of Operation	3
	4. Protection Limits	4
	5. Performance Specifications	7

Section 1. Description

1. General Description

The ADT-222B Air Data Test System (figure 1-1) is a precise, stable, easy to use pressure control system designed to accurately simulate and measure the pneumatic pressures associated with an aircraft in flight. Its operational and design features were selected to meet the needs of those who use, repair, or manufacture precision pneumatic avionic equipment. Consequently, it is ideally suited for laboratory, shop, or production use. In addition to its manual operation capability, the ADT-222B is available with an optional automatic test equipment (ATE) interface which allows remote slave operation of the ADT-222B by an ATE. When equipped with this option, the ADT-222B is fully programmable and capable of being controlled by an ATE system or any programmable terminal that employs an IEEE Standard 488-1975 interface.

Pressure measurement and control is provided in terms of inches of mercury or millibars; altitude in feet or meters; and airspeed in knots or kilometers per hour, as selected by the operator. A special purpose digital processor operates in conjunction with two precision vibrating diaphragm digital pressure sensors and electrically controlled pressure regulation valves to provide high speed control and measurement response with readout displays converted to the units desired by the operator.



ADT-222B Air Data Test System
Figure 1-1

When used as a transfer standard, the ADT-222B accurately measures the pressures applied to its input ports with sufficient resolution and stability to resolve a 1-foot change in altitude at 60,000 feet. Because of its extremely high calibration stability, it can be used to calibrate other laboratory pressure standards and air data test instruments, as well as air data avionic equipment.

When used as a pressure controller, the desired pressure or altitude and airspeed values are entered via digital lever switches on the front panel. Pressure transition rates are selected by digital thumbwheel switches on the front panel and are precisely controlled to provide extremely smooth pressure transitions with no overshoot. A single pushbutton switch initiates control to the newly selected values.

The system also responds to dynamic signals applied to a dynamic input connector on the rear panel. As an example, a function generator can be used to superimpose sinusoidal pressure waves on either P_s or P_t.

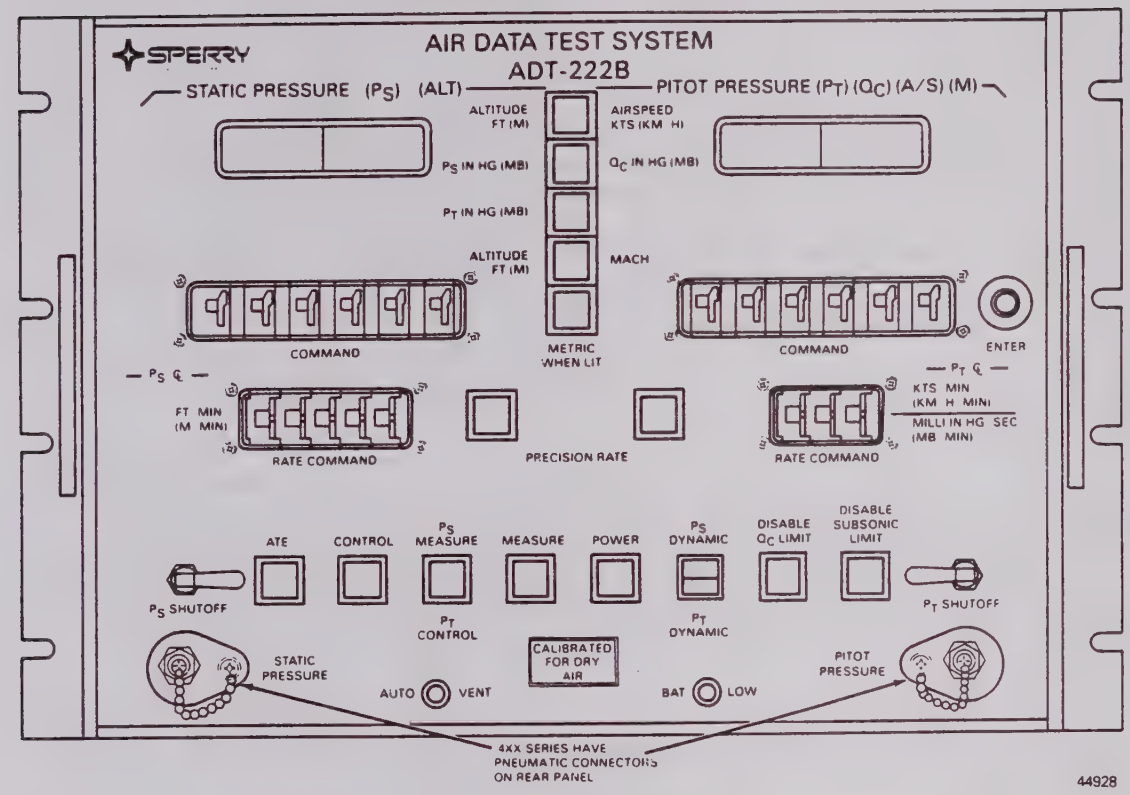
The ADT-222B employs built-in-test (BIT) programming and hardware to monitor its own operation, detect system failures and improper commands from the operator, and shut down the system when a fault is detected. This BIT capability provides fail-safe operation by protecting the unit under test (UUT) against possible hazards during test. Protection is provided against UUT damage caused by either operator error or ADT-222B failure. The operator has the option of selecting subsonic or supersonic protection limits to match the capabilities and requirements of the UUT.

In addition to electrical power, operation of the ADT-222B requires an external pressure source and one or two external vacuum sources. The exact requirements for all of the inputs are listed in section 3 of this chapter. The ADT-222B is calibrated at the factory for use with either dry air (-211, -212, -221, -222, -411, -412, -421, and -422) or dry nitrogen (-213, -214, -223, -224, -413, -414, -423, and -424) as the pressure source. The calibration medium is designated by a front panel decal.

2. Physical Description

The ADT-222B consists of a power supply, digital control cards, two pressure sensors, and two manifold-mounted pneumatic control systems mounted on a shelf. The front panel contains operating controls and displays, and the rear panel contains pressure fittings and connectors for external control and test equipment. It is packaged in an aluminum alloy enclosure designed for either rack mounting or bench top use. Dimensions, weight, and other leading particulars are listed in section 3 of this chapter.

All primary operating controls and displays are located on the front panel, shown in figure 1-2. Pneumatic fittings for connection to the UUT are located on the front panel for units with dash number 2XX, and for units with dash number 4XX, the fittings are on the rear panel. The vertical row of five lighted pushbutton switches at the top center of the front panel visually divides the static pressure panel functions from the pitot (total) pressure panel functions. Four of the pushbutton switches are used to select



Front Panel of ADT-222B
Figure 1-2

the display mode (the parameter and units to be displayed). The fifth pushbutton switch is used to select either English or metric units for the commands and displays. The horizontal row of eight lighted pushbuttons contains the switches to turn the power on and off, select the UUT protection limits, and control the operational modes of the ADT-222B.

With the exception of the RATE COMMAND controls, the static pressure functions on the left side are identical to the pitot pressure functions on the right side. The RATE COMMAND controls are ganged digital thumbwheel switches. The control on the static pressure side contains four switches and thus controls four digits; a fifth digit is fixed at 0. The control on the pitot pressure side contains only three switches and controls three digits. These controls are used to specify the transition rate to be used when changing pressures.

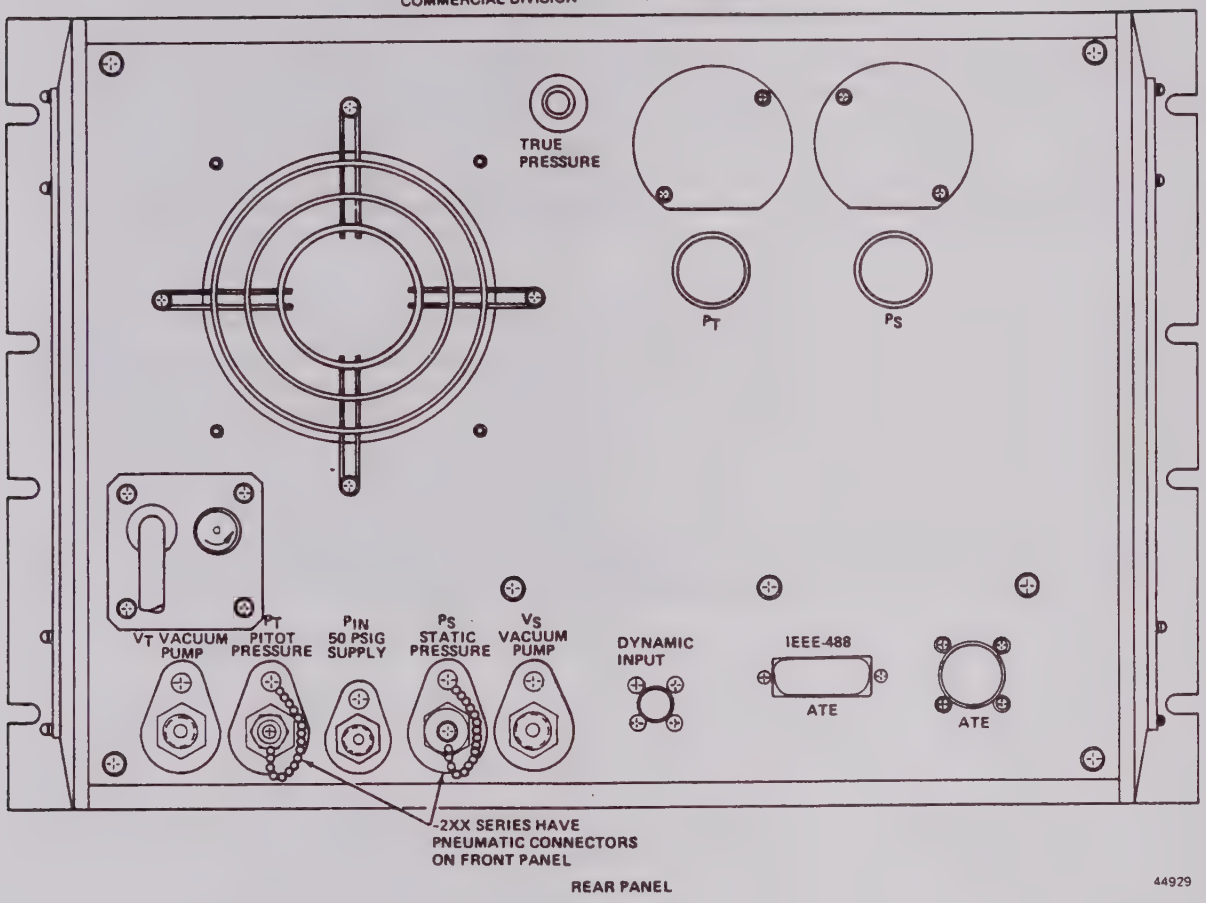
The COMMAND controls are used to specify the next pressure to be applied to the UUT. Each control is a set of six ganged digital lever switches. Directly above each COMMAND control is the pressure readout display. Each display consists of two, three-digit, gas discharge tubes mounted side by side to provide a six-digit readout with a decimal point to the right of each digit. Each digit in the display corresponds to the digit switch in the COMMAND control directly beneath it. These are situated this way because in responding to the COMMAND control, the ADT-222B interprets the placement of the lighted decimal point of the command setting to be in the same digit location as that indicated on the display.

The PRECISION RATE control for each side is a lighted pushbutton switch located next to the RATE COMMAND control and is used to select extra-precise control of the pressure transitions.

The pneumatic fitting for each side is located on the front panel for -2XX units and on the rear panel for -4XX units, and is used to pneumatically connect the UUT to the ADT-222B. The type of fitting used is listed in section 3 of this chapter. A manual pneumatic shutoff valve is provided for each fitting to isolate the UUT from the internal pressure system of the ADT-222B. The manual shutoff valves for all dash numbers are located on the front panel.

The lines marked $P_s\mathbb{C}$ and $P_t\mathbb{C}$ are the center lines of the sensors. The center line represents the altitude reference point (height) at which all pressures are measured.

Fittings for the pressure supply and vacuum supply or supplies are located on the rear panel, shown in figure 1-3, along with the power cord, fuse, dynamic input connector, and the ATE connectors. The fittings and connectors used are listed in section 3 of this chapter. Also located on the rear panel are two internal pressure regulator controls. The pressure regulator controls are factory set and should not be adjusted. The circuit cards and major subassemblies are plug-in and interchangeable for quick and easy maintenance.



Rear Panel of ADT-222B
Figure 1-3

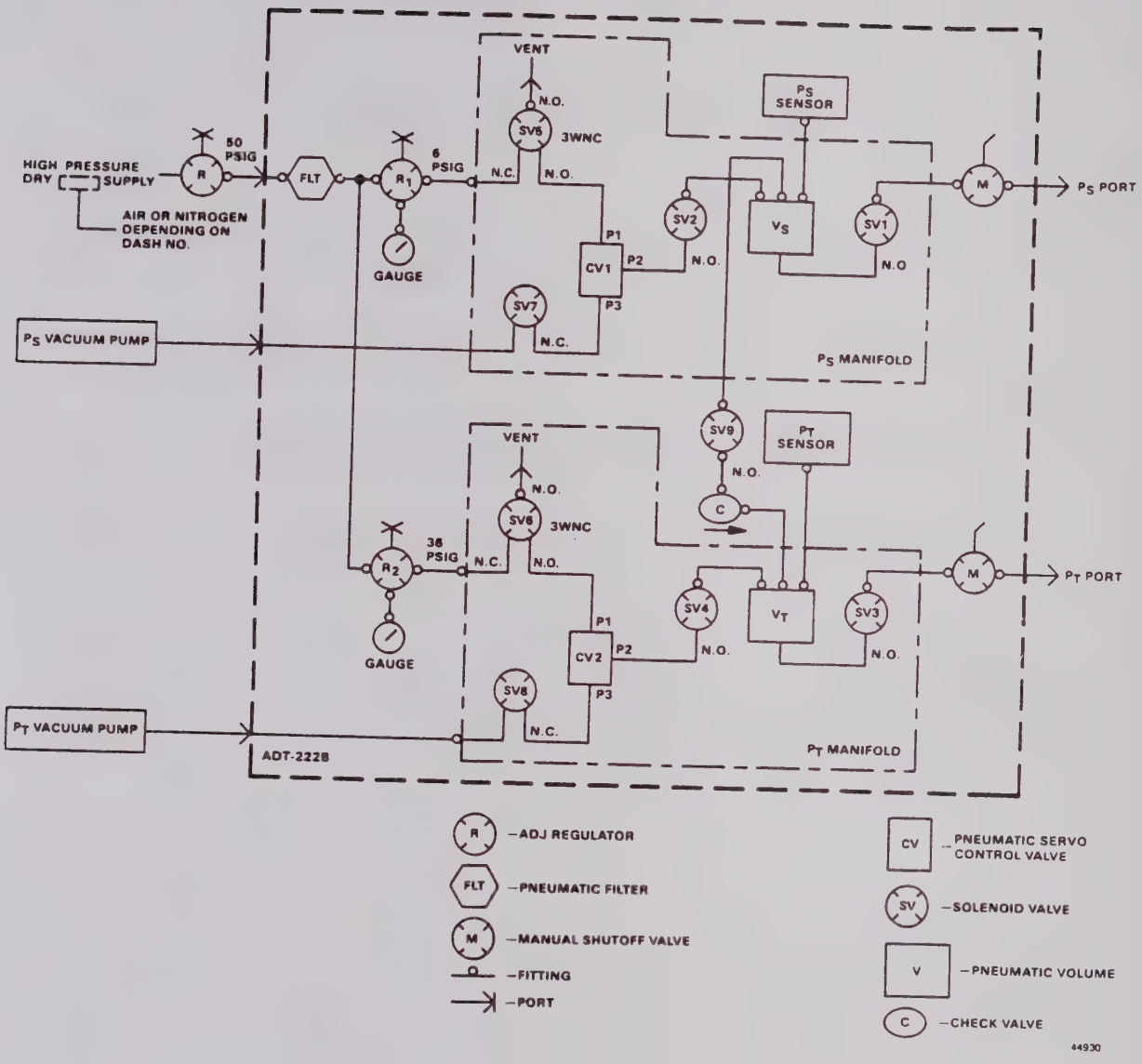
3. Functional Description

The pneumatic system of the ADT-222B, shown in figure 1-4, consists of two pneumatic paths, each containing a pneumatic control section and a measurement section. The sections are isolated from each other and from the UUT connection fittings (P_s and P_t ports) by solenoid operated valves. Extra UUT pneumatic isolation is provided by manual valves.

The measurement section of either path consists of a solenoid valve at each end of the section, a 30-cubic-inch volume tank, and a pressure sensor. The pneumatic control section of either path consists of a pressure regulator for the inlet supply pressure, pneumatic line, fitting, and valve for the vacuum supply, and a pneumatic servo control valve. Both paths join at the pressure supply line and use a common pneumatic filter and a pressure regulator for isolation from the pressure supply.

There are two basic modes of operation, the measure mode and the control mode. In the measure mode, the pneumatic control section is shut off from the measurement section. The measurement section, however, is open to the test ports. Therefore, in the measure mode, valves SV1 and SV3 are open, while valves SV2, SV4, SV5, SV6, SV7, and SV8 are closed. In the control mode, all of the valves are open, and the pressures in both paths are controlled by the respective pneumatic servo control valves, CV1 and CV2.

Operation of the ADT-222B is controlled by a system control section which receives instructions from the operator via the front panel controls or from an ATE via the optional ATE interface. It receives measurement data from the sensors, performs the necessary calculations and conversions, and sends the pressure values to the front panel for display. In the control mode, it also compares the measured values to the input commands and controls the pressure control valves to obtain the desired response. The system control section also performs all BIT functions and causes the ADT-222B to either shut down to protect the UUT, or just ignore the input commands whenever an equipment failure or an operator error is detected. A more detailed description of the operation of the ADT-222B is contained in section 2 of this chapter.



Pneumatic Diagram
Figure 1-4

Section 2. Operating Instructions

1. General

Manual operating procedures are provided below. (Refer to Chapter 3, section 2, for procedures for automatic operation.)

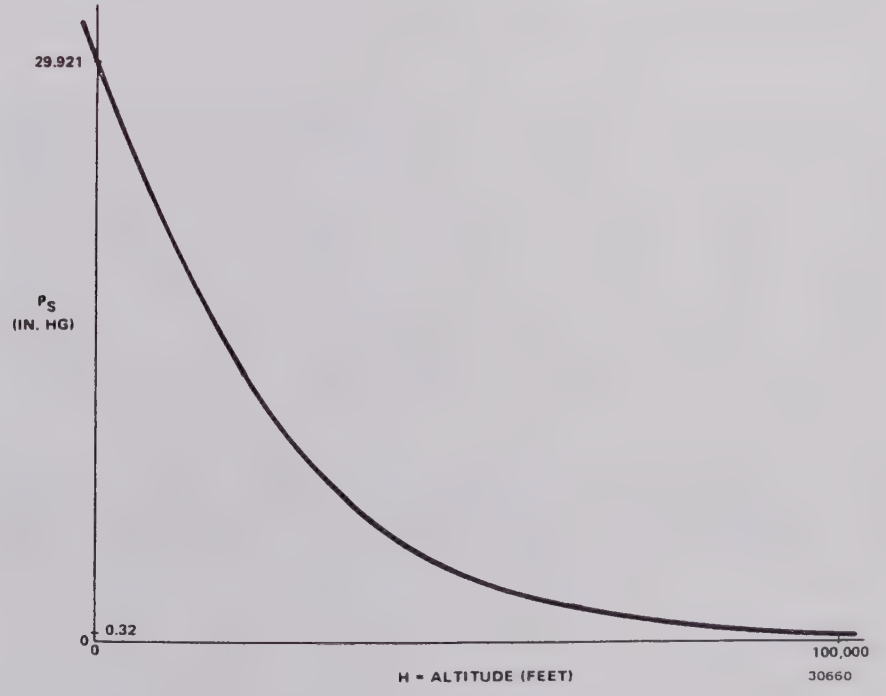
NOTE: Before operating the ADT-222B, the user should familiarize himself with subsections 7 and 8 of this section.

Before operating the ADT-222B, it is helpful for the operator to understand the general relationships between altitude, airspeed, and pressure.

Static pressure (P_S) is the atmospheric pressure experienced by a body at rest. Static pressure is a function of altitude (H), and vice versa.

$$[P_S = f(H),\ H = f(P_S)]$$

The relationship between P_S and H follows the general curve of figure 1-5. Total pressure (P_t) is the pressure experienced by a body as it moves through the atmosphere. For an aircraft in flight, it is the pressure exerted on the nose of the aircraft as it flies in a straight and level path. P_t is the sum of the static pressure and the impact pressure created by the motion of the



Relationship of P_S to H
Figure 1-5

air. Airspeed (V_c) is a function of the impact pressure (Q_c) and, therefore, a function of the relation of P_t to P_s. The relationship between Q_c and V_c follows the general curve of figure 1-6.

$$Q_c = f(V_c),\ V_c = f(Q_c)$$

$$P_t = P_s + Q_c$$

$$V_c = f(P_t - P_s)$$

Mach (M) is the ratio of total pressure (P_t) to static pressure (P_s). The relationship between P_t and P_s follows the general curve of figure 1-7. It should be noted, however, that this curve is in terms of a Q_c to P_s ratio, or where $P_t = Q_c + P_s$.

Subsonic: Mach $\leq$ 1

$$M = \left\{ 5 \left[\left(\frac{P_t}{P_s} \right)^{\frac{2}{7}} - 1 \right] \right\}^{\frac{1}{2}}$$

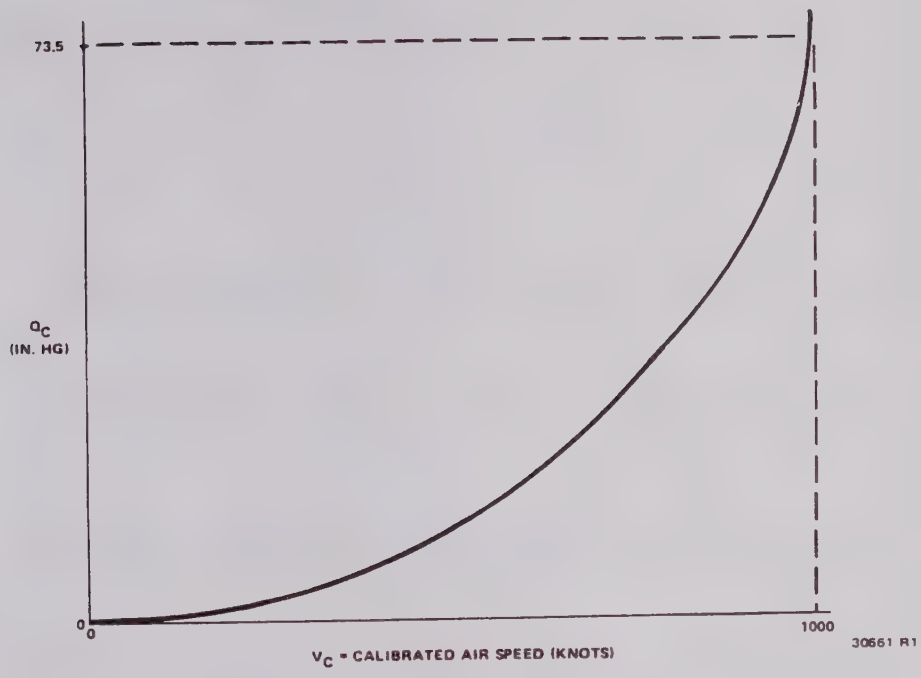
Supersonic: Mach $\geq$ 1

$$\frac{P_t}{P_s} = 166.92158 \left(\frac{M^7}{(7M^2-1)^{2.5}} \right)$$

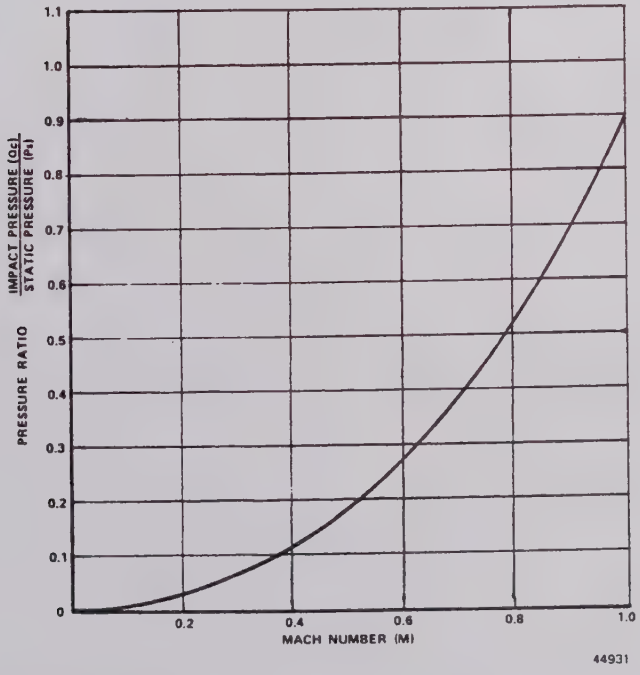
A chart of mach number versus pressure, altitude, and airspeed is provided in figure 1-8.

Many air data instruments are delicate devices, and violent pressure variations can damage or cause changes in the calibration characteristics of the pressure transducers used in these devices. Without the protection limits imposed by the system design, the range and response of the ADT-222B could damage the pressure transducer of the UUT if improperly commanded by the operator. Built-in protection limits are selected by the operator by use of the DISABLE Q_c LIMIT and DISABLE SUBSONIC LIMIT switches. The switch combinations and the resultant protection limits are listed in section 3 of this chapter. The protection limits should be selected to approximate, as closely as possible, the allowable altitude and airspeed ranges of the UUT. The ADT-222B then rejects commands that exceed the selected limits.

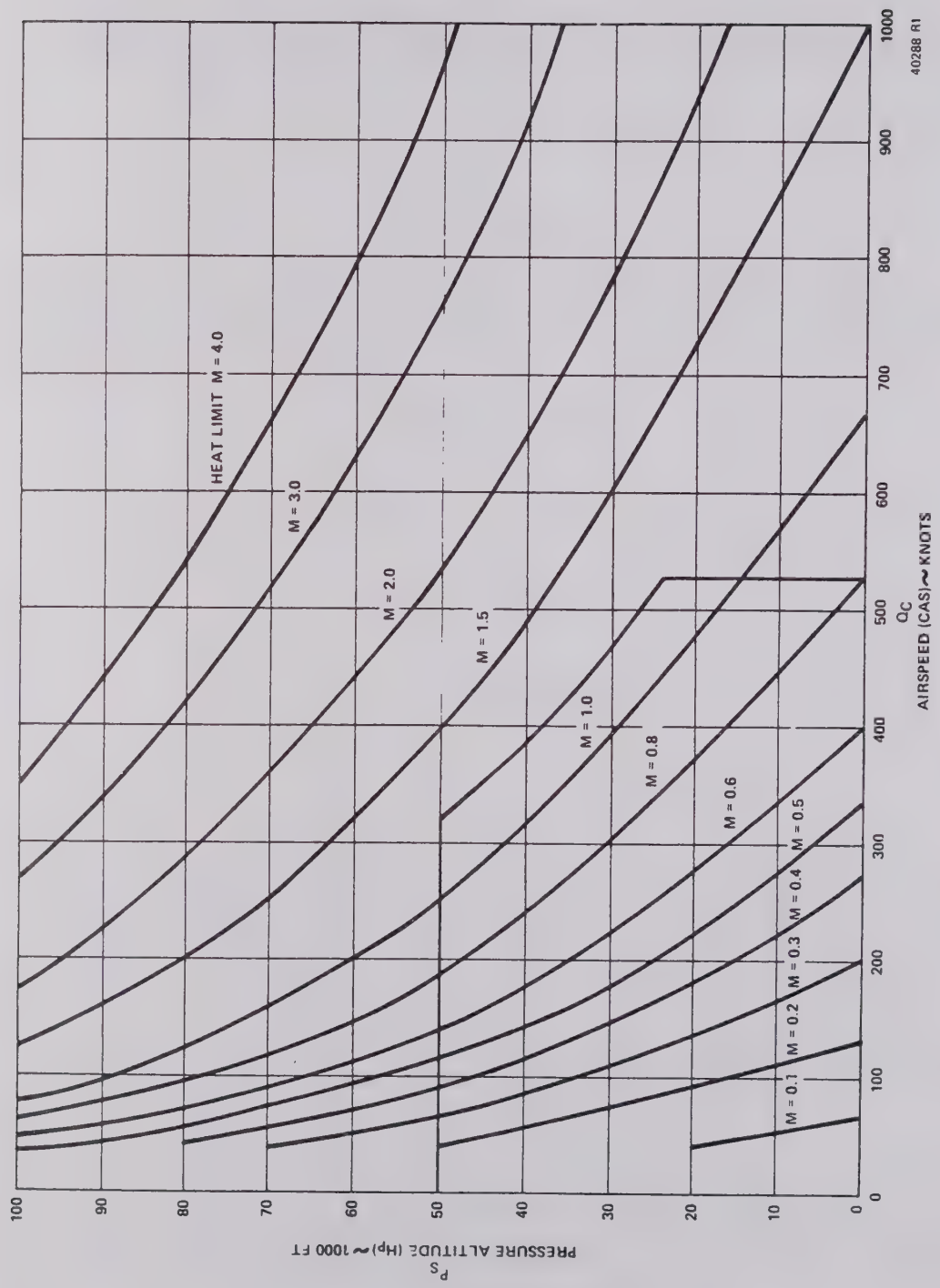
During normal operation, the ADT-222B is controlled entirely by front panel controls. Front panel control connectors and their functions are listed in table 1-1. For reference, the front panel is shown again in figure 1-9. The rear panel contains one calibration control button and eight connectors. The rear panel control, connectors, and their functions are listed in table 1-2.



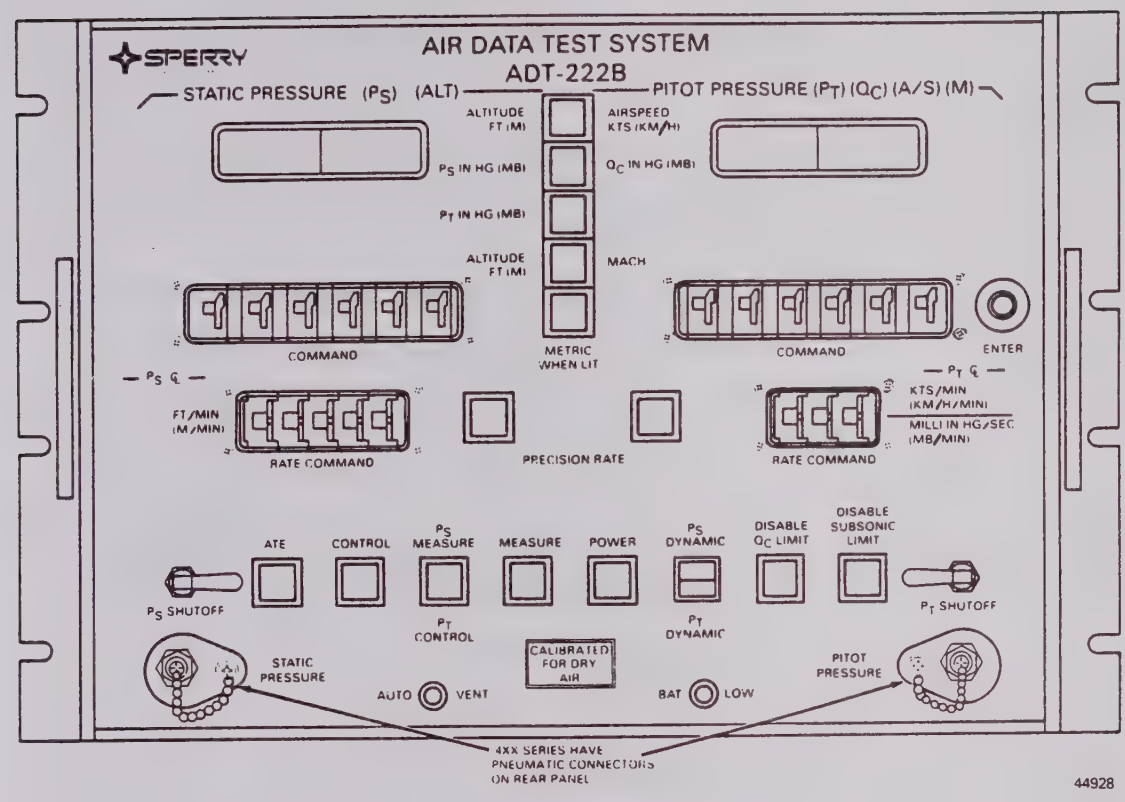
Relationship of Q_C to V_C
Figure 1-6



Mach Number (M) vs Pressure Ratio
Figure 1-7



Mach Number vs Pressure Altitude and Airspeed
Figure 1-8



Front Panel of ADT-222B
Figure 1-9

Front Panel Nomenclature	Ref Des	Purpose
POWER	S16	On/off button with lamp that lights when ac power is applied
STATIC PRESSURE	P_s	UUT static pressure pneumatic connection
PITOT PRESSURE	P_t	UUT pitot pressure pneumatic connection
P_s SHUTOFF	P_s	Toggle valve for pneumatic isolation between UUT and ADT-222B. Valve shown in closed position. Pull to open.
P_t SHUTOFF	P_t	Toggle valve for pneumatic isolation between UUT and ADT-222B. Valve shown in closed position. Pull to open.
ATE	S12	Lighted pushbutton to select automatic control.
CONTROL	S13	Lighted pushbutton to select manual control.
P_s MEASURE/ P_t CONTROL	S17	Lighted pushbutton for selection of split channel measure/control mode. In this mode, the ADT-222B measures the pressure applied to the P_s port while controlling the pressure of the P_t port. Functional in Altitude/Airspeed, P_s/Q_c, and P_s/P_t.
MEASURE	S14	Lighted pushbutton for selection of measure mode to monitor pitot and static pressures applied to pressure ports. Also may be utilized for performance of leak test. Functional in Altitude/Airspeed, P_s/Q_c, and P_s/P_t.
DISABLE Q_c LIMIT	S18	Lighted pushbutton switch, that in conjunction with DISABLE SUBSONIC LIMIT switch, selects UUT protection limits. (Refer to table 1-7.) Flashing light indicates the requested command exceeded a selected limit.

Front Panel Controls, Connectors, and Functions
Table 1-1

Front Panel Nomenclature	Ref Des	Purpose
DISABLE SUBSONIC LIMIT	S19	Lighted pushbutton switch, that in conjunction with DISABLE Q_C LIMIT switch, selects UUT protection limits. (Refer to table 1-7.) Flashing light indicates the requested command exceeded a selected limit.
STATIC PRESSURE (P_S) (ALT)	-	Six-digit gas discharge tube display
PITOT PRESSURE (P_t) (Q_C) (A/S) (M)	-	Six-digit gas discharge tube display
ALTITUDE FT (M)/ AIRSPEED KTS (KM/H)	S1	Lighted pushbutton to select and display control or measure mode
P_S IN HG (MB)/ Q_C IN HG (MB)	S2	Lighted pushbutton to select and display control or measure mode
P_S IN HG (MB)/ P_t IN HG (MB)	S4	Lighted pushbutton to select and display control or measure mode
ALTITUDE FT (M)/ MACH	S3	Lighted pushbutton to select and display measure mode
METRIC WHEN LIT	S20	Selects metric units when lit
PRECISION RATE (left side)	S6	Lighted pushbutton for selection of precision rate control of altitude or P_S transitions
PRECISION RATE (right side)	S7	Lighted pushbutton for selection of precision rate control of airspeed, Q_C, or P_t transitions
COMMAND	S8, S10	Digital lever switches for programming static and pitot pressure commands (Units and lighted decimal placement match the display mode selected.)
RATE COMMAND FT/MIN (M/MIN)	S9	Thumbwheel for preselecting transition rates for static pressure changes (Units are always whole feet/minute or whole meters/minute.)

Front Panel Controls, Connectors, and Functions
Table 1-1 (cont)

Front Nomenclature	Ref Des	Purpose
RATE COMMAND KTS/MIN (KM/H/MIN) MILLI IN HG/SEC (MB/MIN)	S11	Thumbwheel for preselecting transition rates for airspeed, Q_C, and total pressure changes (Units match the display mode selected. Decimal is always at far right.)
ENTER	S5	Command enter pushbutton to activate the ADT-222B to execute all commands shown on the front panel
P_S DYNAMIC/ P_t DYNAMIC	S15	Split lighted pushbutton to permit P_S or or P_t dynamic testing in any control mode utilizing an analog function generator input at rear panel. Switch advances from off to P_S DYNAMIC to off to P_t DYNAMIC to off as pushbutton is depressed.
AUTO/VENT	L1	Presently not functional
BAT/LOW	L2	Presently not functional
P_t ℄	-	Represents total pressure reference center line. All P_t measurements are made with respect to this line.
P_S ℄	-	Represents static pressure reference center line. All P_S measurements are made with respect to this line.

Front Panel Controls, Connectors, and Functions
Table 1-1 (cont)

Rear Panel Nomenclature	Ref Des	Purpose
TRUE PRESSURE	-	Pushbutton switch used during calibration to initiate calibration error calculation and storage
V_T VACUUM PUMP	-	ADT-222B pitot pressure vacuum connection
P_T PITOT PRESSURE	-	UUT pitot pressure pneumatic connection
P_{IN} 50 PSIG SUPPLY	-	ADT-222B pressure connection
P_S STATIC PRESSURE	-	UUT static pressure connection
V_S VACUUM PUMP	-	ADT-222B total pressure vacuum connection
DYNAMIC INPUT	J2	Dynamic input electrical connection
IEEE-488/ATE	J3	ASCII bus electrical connection
ATE	J4	ASCII bus plus discretes electrical connection

Rear Panel Controls, Connectors, and Functions
Table 1-2

2. System Initialization

CAUTION: THE ADT-222B HAS AUTOMATIC VENTING THAT OCCURS WHENEVER POWER IS TURNED ON, INTERRUPTED, OR THE UNIT ENTERS THE SELF TEST MODE. DURING VENTING, ALTITUDE RATES ARE DEPENDENT ON LOAD VOLUME AND MAY BECOME VERY SMALL OR VERY LARGE. AIRSPEED, AS WELL AS MACH NUMBER, MAY INCREASE BY AN AMOUNT SUFFICIENT TO EXCEED THE SUBSONIC SSL/QCL FLIGHT PROFILE ENVELOPE. IF DESIRED, THIS CAPABILITY MAY BE DISABLED BY PERFORMING THE FOLLOWING STEPS:

1. REMOVE SOLENOID VALVE SV9, CHECK VALVE C AND LINES TO PNEUMATIC VOLUMES V_S AND V_T.

2. PLUG THE PORTS ON V_S AND V_T WHERE THE LINES WERE JUST REMOVED.

3. PLUG THE VENT PORTS ON SV5 AND SV6.

NOTE: A safe and effective venting system (OCTAVENT) has been developed, but is not yet in production. (Contact Sperry Flight Systems for details.)

Start operation of the ADT-222B by performing the following steps.

NOTE: These operating procedures are based on the assumption that the ADT-222B has been properly installed and has been allowed to warm up and stabilize in the measure mode. (Refer to Chapter 2 for installation and initial turn-on procedures.) The required warmup time is 30 minutes.

A. Open the two manual shutoff valves, P_S SHUTOFF and P_t SHUTOFF, by pulling the valve levers out so they are perpendicular to the plane of the front panel. This connects the ADT-222B pneumatics to the P_S and P_t ports. These ports should remain open whenever the ADT-222B is not in use to vent the pneumatic system to the atmosphere. They should also remain open during all normal operations of the ADT-222B.

NOTE: The ADT-222B and the vacuum pumps may be left on 24 hours a day. If the system is not being used, it should be placed in the measure mode with the front panel shutoff valves open to the atmosphere. Place the attached caps loosely over the P_S and P_t front panel pneumatic fittings. In the measure mode, there is no consumption of inlet air and thus no air flow through the vacuum pumps. (To turn the system off, refer to Chapter 2, section 5 for shutdown procedures to avoid the possibility of allowing oil from the vacuum pumps to enter the ADT-222B.)

B. Press the POWER pushbutton to turn on the power to the ADT-222B. The green POWER pushbutton should be lighted. The ADT-222B enters initiated BIT and begins the self test routine. The lighted pushbuttons on the front panel all flash five times so that the operator may check for a defective light. Some lights may flash at different rates. Some lights may stay on and not flash. However, all lamps should light, including decimal points located in the COMMAND switch displays.

After the light flashing sequence is finished, the ADT-222B cycles the displays through 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, (Blank), C, -d, E, and F. Also, the decimal point cycles through each of its six positions from left to right. The decimal point at the far right may flash with each display change. This is normal. The displays continue to cycle in this fashion until the next step is performed.

2. C. Press one of the top four vertical display mode pushbuttons, plus the METRIC WHEN LIT pushbutton, if metric units are desired. This causes the ADT-222B to enter the measure mode. The MEASURE pushbutton lights, and the displays stop cycling and display the ambient pressure in the units selected by the display mode button.

   NOTE: If the ADT-222B does not respond and the displays do not stop cycling when a display mode is selected, BIT has detected a failure and does not allow the ADT-222B to enter a normal operating mode. Maintenance is required to correct the fault.

3. Measure Mode Operation

This mode is entered in either of two ways. It is always entered at the end of the initiated BIT (unless an actual failure has been detected by BIT) or it is entered from the other modes by pressing the desired MEASURE pushbutton (MEASURE or P_S MEASURE/P_t CONTROL). The ADT-222B is operated in the measure mode by performing the following steps:

A. Open the manual valves (if not already open) and select the desired display mode by pressing one of the four display mode pushbuttons:

(1) ALTITUDE FT (M)/AIRSPEED KTS (KM/H)
(2) P_S IN HG (MB)/Q_C IN HG (MB)
(3) P_S IN HG (MB)/P_t IN HG (MB)
(4) ALTITUDE FT (M)/MACH

NOTE: If metric units are desired, press METRIC WHEN LIT pushbutton in addition to the mode selected.

B. The displays indicate the pressures applied at the input ports in the units selected by the operator.

C. Connect the UUT to the P_S and P_t input ports. The manually operated valves should remain open.

4. Control Mode Operation

The ADT-222B is operated manually in the control mode by performing the following steps:

CAUTION: THE MANUAL SHUTOFF VALVES MUST BE LEFT OPEN WHENEVER A UUT IS CONNECTED TO THE ADT-222B. THE ONLY WAY AN OPERATOR CAN MAKE THE ADT-222B DAMAGE A UUT IS BY LEAVING THE MANUAL SHUTOFF VALVES CLOSED WHEN COMMANDING THE SYSTEM TO CHANGE PRESSURES. OPENING THE VALVES AFTER CHANGING PRESSURES CAN CAUSE DAMAGING PRESSURE SURGES TO BE APPLIED TO THE UUT.

NOTES: 1. These procedures assume that a UUT is connected to the system. For familiarization purposes, these procedures can be performed without connection to a UUT by closing the P_s and P_t SHUTOFF valves.

2. If, for any reason, the operator wants to stop the pressure command, press the MEASURE pushbutton. This immediately disconnects the ADT-222B pneumatic control system from the UUT and stops the pressure changes.

4. A. Set the states of the DISABLE Q_c LIMIT and the DISABLE SUBSONIC LIMIT switches by pressing them to turn them on or off, as applicable, to select the appropriate protection limits for the UUT. (The available limits are given in section 3 of this chapter.) If a UUT is connected to the system, ensure the manual shutoff valves are open.

NOTE: Once the switches have been set to match the UUT limits, do not change them until the test procedure is completed and the UUT has been disconnected from the ADT-222B. Even if the lights start flashing during your test procedure, don't touch them. Flashing lights indicate that a command has been entered that would cause the system to exceed the established protection limits for the UUT and the ADT-222B will not accept the erroneous command. Pressing the flashing button would change the protection limits and enable the system to respond to a command which could possibly damage the UUT.

B. Press the CONTROL pushbutton. This causes the system to enter the control mode and the CONTROL pushbutton lights. If the room is quiet, the closing of solenoid valves SV1 and SV3 followed by the opening of solenoid valves SV2, SV4, SV5, SV6, SV7, and SV8 can be heard. This valve configuration isolates the UUT from the internal pneumatic system of the ADT-222B. The internal pressure is then controlled to match the last pressures measured from the input ports. When the internal pressures have been stabilized, the opening of valves SV1 and SV2 to connect the UUT to the internal pneumatic system of the ADT-222B can be heard. This action initializes the internal pressures of the ADT-222B to those of the UUT to prevent pressure surges which might harm the UUT. You are now ready to proceed. Total elapsed time is approximately 15 seconds.

4. C. Press one of the three applicable mode pushbuttons to select the desired control mode:

ALTITUDE FT (M)/AIRSPEED KTS (KM/H)
P_S IN HG (MB)/Q_C IN HG (MB)
P_S IN HG (MB)/P_t IN HG (MB)

The selected button lights and the display presents the measured values in the appropriate units.

NOTE: If metric units are desired, press METRIC WHEN LIT pushbutton in addition to the mode selected.

D. Set the COMMAND switches to the next desired display values. Be certain that the display mode matches the units of your input command. The lighted decimal placement on the COMMAND switches matches the decimal placement on the display directly above each COMMAND switch. For example, if the P_S display now reads 28.564 inches Hg and the next command is to go to precisely 30 inches, set the P_S COMMAND switches to 030000, as there are three digits to the right of the decimal point.

E. Set the RATE COMMAND switches to the desired transition rates. The decimal point is always to the far right-hand side. The P_S rate is always in feet per minute or meters per minute. The P_t rate is in knots per minute, kilometers per hour per minute, milli-inches Hg per second, or millibars per minute, depending upon the display mode and units (English or metric) selected.

F. Press the ENTER pushbutton to initiate the command. The system responds by changing the pressures to the commanded values at the commanded rates. The pressures continue to change at the commanded rates until the final values are approached. At this time, the rate gradually decreases to zero, which allows the control system to stabilize at the commanded pressures without overshoot.

G. If a precision rate is desired, press the appropriate PRECISION RATE pushbutton. The left pushbutton selects P_S precision rate and the right pushbutton selects P_t precision rate. The PRECISION RATE light flashes, which indicates that precision rate is requested but not yet achieved, or the error is greater than 1 percent. After the ENTER command pushbutton is pressed, the light continues to flash to indicate changing pressure(s) toward the commanded value(s) at a rate greater than 1 percent. When the transition rate accuracy is within 1 percent, the PRECISION RATE light goes steady. When the precision rate starts to diminish approaching the commanded value, the PRECISION RATE light goes out and then starts to flash again when the pressure has stabilized. If precision rate control is not required for the next command, press the PRECISION RATE pushbutton again and the light goes off.

4. H. Whenever an operator commands a large pressure rate into a large volume, the possibility exists for the control system to saturate with the control valve wide open. If this condition occurs, the control system enters auto slew on the side that is saturated. Auto slew maintains the expected altitude (H) and airspeed (V_C) correspondence despite P_S or P_t saturation; therefore, the transition path follows the desired path but takes longer. When the ADT-222B is in auto slew, the two least significant digits in the readout display AS.

I. When it is desirable to change from one pressure to another in the shortest possible time, the ADT-222B can be put in commandable slew. To enable commandable slew, the DISABLE Q_C LIMIT and DISABLE SUBSONIC LIMIT indicator switches must be illuminated, and the RATE COMMAND thumbwheel switch on the desired side or sides must be set to 9. Commandable slew is then activated by depressing the ENTER pushbutton switch, and the appropriate readout displays CS in the two least significant digits.

J. Repeat steps C. thru I. as required to perform the UUT test procedure.

NOTE: Press the MEASURE pushbutton to rapidly stop the pressure command. This immediately disconnects the ADT-222B control system from the UUT and stops the pressure changes.

K. When power to the ADT-222B is turned on or interrupted, or the unit enters the self test mode for any reason, the unit automatically vents both P_S and P_t channels and the UUT to atmospheric pressure. Venting can be observed on the readout by grounding pin J4-35 on the rear panel. The P_S/P_t indicator-switch illuminates and the two least significant digits on the readout display AE (automatic exhaust).

L. Return the system to approximately ambient pressure. This can be done by commanding the system to return to any of the following:

Ambient altitude and zero airspeed
Ambient P_S and zero Q_C
Ambient P_S and P_t

M. Press the MEASURE pushbutton to return the ADT-222B to the measure mode. The MEASURE pushbutton lights. Solenoid valves SV2, SV4, SV5, SV6, SV7, and SV8 close, which isolates the UUT from the control section of the pneumatic system.

N. Disconnect the UUT from the ADT-222B.

5. Leak Test Operation

Test the pressure retaining capacity of the ADT-222B/UUT test setup by performing the following steps:

NOTE: To test the ADT-222B by itself, refer to Chapter 4, section 2.

A. Ensure that the manual shutoff valves are open.

CAUTION: THE OPERATOR COULD DAMAGE THE UUT BY OPENING THE MANUAL SHUTOFF VALVES AFTER THE ADT-222B HAS BEEN COMMANDED TO A PRESSURE.

B. Press the P_S IN HG/P_t IN HG pushbutton.

C. Select the UUT protection limits by pressing the DISABLE Q_C LIMIT and the DISABLE SUBSONIC LIMIT switches to light the pushbuttons as applicable.

D. Connect the UUT to the P_S and Pt ports.

E. Press the CONTROL pushbutton to enter the control mode.

F. Refer to table 1-3 and enter the following commands:

(1) Set P_S COMMAND to the value shown in table 1-3 (in accordance with DQCL lights).

(2) Set P_t COMMAND to the value shown in table 1-3 (in accordance with DQCL and DSSL lights).

(3) Set P_S RATE COMMAND to 30000 ft/min.

(4) Set P_t RATE COMMAND to 300 milli-in. Hg/sec.

G. Press the ENTER pushbutton.

H. After the commanded pressures have been established, press the MEASURE pushbutton. Wait 5 or 6 minutes for the system temperature to stabilize and read the displays.

I. Wait 1 minute and read the displays again. The difference between the initial values and the currently displayed values should not be greater than that specified for the UUT (in inches Hg).

J. Re-enter the control mode.

5. K. Enter the following commands in accordance with DQCL and DSSL lights:

(1) Set P_s COMMAND to the value shown in table 1-3.

(2) Set P_t COMMAND to the value shown in table 1-3.

L. Press the ENTER pushbutton.

M. After the commanded pressures have been established, press the MEASURE pushbutton. Wait 5 or 6 minutes to allow the system temperature time to stabilize and read the displays.

N. Wait 1 minute and read the displays again. The leak rate should not be greater than that specified for the UUT.

O. Re-enter the control mode and return the system to ambient pressure.

P. Return to the measure mode.

Q. Disconnect the UUT from the ADT-222B.

Leak Test Step	DQCL Light [1]	DSSL Light [1]	P_s Command	Pt Command
5.F	0	0	31.000	40.000
	0	1	31.000	89.000
	1	0	31.000	40.000
	1	1	31.000	89.000
5.K	0	0	3.200	3.200
	0	1	.500	1.500
	1	0	3.200	3.200
	1	1	.500	.500

[1] 0 = Light Off (limit active)
1 = Light On (limit disabled)

Leak Test Commands
Table 1-3

6. Dynamic Operation

The ADT-222B can be driven to produce sinusoidal or other forms of variations in either P_S or P_t for dynamic testing of a UUT. This may be done in any of the three control modes. The ADT-222B has the capability of having only one pressure dynamically driven at a time; the other pressure must remain constant. In the P_S MEASURE/P_t CONTROL mode, only the P_t channel pressure can be modulated by the dynamic input. Frequency response of either channel of the ADT-222B that uses the dynamic input is limited by the load volume connected to that channel, and the corner frequency is 1.5 Hz or greater for a load of 60 cubic inches. For dynamic operation, follow the procedures below.

A. Connect a function generator (Wavetek 154, or equivalent) to the dynamic input connector on the rear panel.

B. Turn the amplitude control of the function generator to zero.

C. Turn the function generator on and select a square wave with a period of approximately 5 seconds.

D. Put the ADT-222B in the command mode and enter the steady state P_S and P_t values.

E. When the ADT-222B has reached both steady state values, press the P_S DYNAMIC/P_T DYNAMIC pushbutton until the desired state is illuminated.

F. Adjust the amplitude control of the function generator to obtain the desired magnitude of oscillation as indicated on the display. Then select the desired waveform and frequency on the function generator.

Example: If P_t is to oscillate ± 0.1 inch Hg from a steady state value of 40.0 inches Hg, adjust the amplitude control until the P_t display changes between 40.100 and 39.900 inches Hg.

G. To return to normal operation, press the P_S DYNAMIC/P_T DYNAMIC pushbutton again and the dynamic response will cease.

7. Failure Procedures

There are no special procedures to be followed if the system indicates a failure while in the measure mode, since no pressure is applied to the UUT. However, if the system indicates a failure by displaying "FFF" while in the control mode, the following procedures must be performed to avoid possible damage to the UUT.

A. Close the P_S and P_t manual shutoff valves. Do not operate any other controls on the ADT-222B until these valves are closed.

CAUTIONS: 1. STEP B. DEPENDS UPON THE TYPE OF UUT CONNECTED TO THE ADT-222B.

2. DO NOT DISCONNECT THE UUT BEFORE READING THE FOLLOWING:

7. B. If the UUT is an altitude device requiring a single pressure input, loosen the pneumatic connection slightly to allow the pressure to slowly bleed to ambient. Care must be taken not to allow a sudden large pressure change which could damage the UUT.

If the UUT requires both P_s and P_t inputs, but does not contain a differential pressure (or Q_c) sensor, loosen the pneumatic connections slightly to slowly bleed off the pressures. Again, care must be taken to avoid a sudden pressure change which could damage the UUT.

If the UUT is connected to both the P_s and P_t ports and contains a Q_c sensor, the pressures must be bled off by following the procedure in steps (1) thru (5). The objective of this procedure is to avoid either a negative Q_c or a Q_c larger than that for which the UUT was designed. Not adhering to this procedure could result in damage to the UUT Q_c sensor.

(1) Refer to the UUT specifications to determine the output of the UUT related to Q_c.

(2) Determine the values of this output that correspond to the maximum Q_c and minimum Q_c limits of the UUT. (Refer to section 2 of this chapter, paragraph 1, General Requirements, for the relationships between P_s, P_t, Q_c, altitude, and airspeed.)

(3) While monitoring the UUT output, carefully bleed the P_s pressure toward ambient by loosening the P_s connection at either the ADT-222B or the UUT. When the UUT output approaches the value corresponding to the Q_c limit, stop bleeding the pressure by tightening the P_s connection. Take care not to reach or exceed the Q_c limit.

(4) Continue monitoring the UUT output and bleed the P_t pressure in the same manner. Stop bleeding the pressure when the UUT output approaches the value corresponding to the opposite Q_c limit. Take care not to reach or exceed the Q_c limit.

(5) Continue to bleed off the P_s and P_t pressures by alternately performing steps (3) and (4), taking care to keep the UUT output within the Q_c limits.

C. When all of the pressure has been bled off, disconnect the UUT from the ADT-222B.

D. Turn off the vacuum pumps and pressure supply and disconnect the vacuum and pressure supply lines. (Refer to Chapter 4 for system maintenance.)

8. Error Messages

The built-in test function of the ADT-222B monitors the system's operation to detect any failures. When multiple failures occur, the display overlays the given failure codes for the display output. When single failures occur, one of the following occurs.

A. The displays indicate XXFFFF if a failure has occurred within the system.

B. A display indicates XXXCCC if one of the sensors has not warmed up properly. A cold sensor can cause erroneous measurements.

C. A display indicates XXXXdd if one of the sensors is too hot. A hot sensor can produce erroneous measurements.

D. A display indicates XXXXXE if the system is incapable of producing the requested response. This generally indicates a leak or other malfunction in the pneumatic control section of the ADT-222B. The E also appears if the operator tries to operate the ADT-222B outside its operational limits. For example, in the altitude/airspeed mode, with P_s and P_t equal (as if they are both open to ambient), the AIRSPEED display indicates 22E. The lowest airspeed the system can accurately measure is 22 knots (29.8 kilometers/hour); however, values lower but of variable accuracy are possible and are displayed for relative reference only.

E. The DQCL or DSSL pushbutton flashes if the operator commands a pressure response that is beyond the established UUT protection limits.

F. The DQCL pushbutton flashes if the operator commands a pressure response that exceeds the established airspeed limit.

G. The DSSL pushbutton flashes if the operator commands a pressure response that attempts a mach limit violation.

Section 3. Specifications

1. Leading Particulars

The leading particulars of the ADT-222B are listed in table 1-4.

Dimensions	
Height	12.25 inches maximum
Width	19.00 inches maximum
Length	23.00 inches maximum
Weight	75.8 pounds
Power (single phase) [1]	115/230 volts ± 10% RMS, 45 to 440 Hz, 175 VA maximum
Warmup Time	30 minutes maximum
Operating Temperature	+50 to +110 °F (+10 to +43 °C)
Pressure Source	Dry air or dry nitrogen, regulated, at 50 ± 5.0 psig (Refer to Chapter 2, section 2, paragraph 3, Pressure Supply.)
Vacuum source	
Dual pump configuration	
P_s	50 liters per minute free air displacement
P_t	50 liters per minute free air displacement
Single pump configuration	
P_s and P_t	300 liters per minute free air displacement

NOTE: The dual pump configuration is recommended because maximum rates can be achieved while driving larger loads, which eliminates cross talk between the P_s and P_t vacuum lines.

Leading Particulars
Table 1-4

Programming Interface	IEEE Standard 488-1975, ASCII
Fuse	3.0 amperes slo-blo (115-volt units) 1.5 amperes slo-blo (230-volt units)
Lamps (pushbutton indicators)	No. 327, 28 volts dc

[1] Refer to the ADT-222B configurations table in the FOREWORD for voltages applicable to specific part numbers.

Leading Particulars
Table 1-4 (cont)

2. Connections and Fittings

Table 1-5 lists the connectors and fittings required to mate with the ADT-222B.

CONNECTION	CONNECTOR
Inlet Pressure (P_{in})	1/4 inch 37-1/2 degree male flare (MS-33656-4)
Vacuum Source (V_s and V_t)	3/8 inch 37-1/2 degree male flare (MS-33656-6)
Static Port (P_s)	3/8 inch 37-1/2 degree male flare (MS-33656-6)
Pitot Port (P_t)	1/4 inch 37-1/2 degree male flare (MS-33656-4)
Dynamic Input	Bendix Part No. JTP02RE8-35 mates with Bendix Part No. JT06RE8-98 P(SR)
Test	Bendix Part No. JTP02RE20-35 mates with Bendix Part No. JT06RE20-35 P(SR)

Connections and Fittings
Table 1-5

CONNECTION	CONNECTOR
ATE IEEE-488	Amphenol Part No. 57-20240-2 mates with Sperry Part No. 4031162
ATE	Bendix Part No. JTPO2RE14-35S mates with Bendix Part No. JTO6RE14-35 P(SR)
Power	User selection (no connector supplied with system)

Connections and Fittings
Table 1-5 (cont)

3. Range of Operation

The ADT-222B can operate within the functional ranges listed in table 1-6. These are maximum ranges available with the Q_C and subsonic protection limits disabled.

Function	Control Range [1]	Measure Range
P_S	0.500 to 32.000 in. Hg 16.9 to 1083.6 MB	0.320 to 40.000 in. Hg 10.8 to 1354.6 MB
Pt	1.500 to 90.000 in. Hg 50.8 to 3047.7 MB	0.500 to 100.000 in. Hg 16.9 to 3386.4 MB
Qc	-30.500 to 89.500 in. Hg -1032.8 to 3030.8 MB	-39.500 to 99.680 in. Hg -1337.6 to 3375.6 MB
Altitude	-1800 to 90,000 ft -549 to 27,432 M	-1800 to 100,000 ft -549 to 30,480 M
Airspeed (CAS)	32 to 1000 knots 59.3 to 1852.0 KM/H	23.0 [2] to 1000 knots 42.6 [2] to 1852.0 KM/H

Operating Range
Table 1-6

Function	Control Range [1]	Measure Range
Altitude Rate	0 to 40,000 ft/min [3] 0 to 12,190 M/min [3] 0 to 65,000 ft/min [4] 0 to 19,810 M/min [4]	-
Airspeed Rate	0 to 500 knots min [3] 0 to 926 KM/H/min [3] 0 to 700 knots/min [4] 0 to 999 KM/H/min [4]	-
Mach Range	-	0.100 to 5.000

[1] Operation in these ranges are guaranteed for P_s, Pt, Q_c, Altitude, and Airspeed.

[2] Display range is extended to zero using a straight line. Operation in this region is indicated by the presence of an E in the LSD of the airspeed or mach display reading. This keeps the display alive for operation in these regions.

[3] For external volumes larger than 200 cubic inches

[4] For external volumes smaller than 200 cubic inches

NOTE: Faster altitude and airspeed rates may be obtained by utilizing commandable slew, although the safety limits are removed.

Operating Range
Table 1-6 (cont)

4. Protection Limits

The UUT Protection limits imposed by the system are shown in table 1-7. These limits are selected either by the disable limit switches on the front panel, or by the ATE. The limit switch states are shown in the table and follow the legend below.

DQCL Light = DISABLE Q_c LIMIT pushbutton light
DSSL Light = DISABLE SUBSONIC LIMIT pushbutton light
ON = Pushbutton light is on. The limit is disabled. This corresponds to an ASCII "1" from the ATE.
OFF = Pushbutton light is off. The limit is engaged. This corresponds to an ASCII "0" from the ATE.
< = Less than
> = Greater than

Front DQCL Light	Panel DSSL Light	DQCL	DSSL	Ps Limit	Pt Limit	Qc Limit	Airspeed Limit (knots)	Altitude Limit (feet)	Altitude Rate Limit (ft/min)	Mach Limit
Off	Off	0	0	$P_s \geq 2.692$ $P_s \leq 32.019$	$P_t \geq 2.692$ $P_t \leq 47.426$	$Q_c \geq -2.016$ $Q_c \leq 15.407$	$V_c \geq .0$ $V_c \leq 525.0$	$H \geq -1888$ $H \leq 55,008$	See Note 3	$M \leq 1.1$
Off	On	0	1	$P_s \geq .480$ $P_s \leq 32.019$	$P_t \geq 1.480$ $P_t \leq 90.019$	$Q_c \geq -2.016$ $Q_c \leq 74.003$	$V_c \geq 0$ $V_c \leq 1002.6$	$H \geq -1888$ $H \leq 91,337$	65,000	$M \leq 3.5$
On	Off	1	0	$P_s \geq 2.692$ $P_s \leq 32.019$	$P_t \geq 2.692$ $P_t \leq 47.431$	$Q_c \geq -29.327$ $Q_c \leq 44.739$	$V_c \geq 0$ $V_c \leq 813.4$	$H \geq -1888$ $H \leq 55,008$	65,000	None
On	On	1	1	$P_s \geq .312$ $P_s \leq 40.003$	$P_t \geq .480$ $P_t \leq 100.019$	$Q_c \geq -39.523$ $Q_c \leq 99.707$	$V_c \geq 0$ $V_c \leq 1008.4$	$H \geq -2000$ $H \leq 100,683$	None Note 4	None

NOTES:
1. The OFF state for both DQCL and DSSL is automatically selected with power turn on.
2. Refer to table 1-6 for guaranteed control pressure ranges.
3. $\dot{H}$ maximum is controlled by A6 Switch 1 bits 7 and 8 per table below, when DSSL and DQCL lights are off.

Bit 7 (HDOT 2)	Bit 8 (HDOT 1)	Limit (ft/minute)
0	0	$\dot{H} \leq 65,000$
0	1	$\dot{H} \leq 20,000$
1	0	$\dot{H} \leq 10,000$
1	1	$\dot{H} \leq 6,000$

4. Commandable slew removes all rate limits to minimize time between pressure points. See Slew, Section 4.5.8.

UUT Protection Limit Ranges
Table 1-7

5. Performance Specifications

The following performance specifications are listed in tables contained in this section:

Resolution is listed in table 1-8.
Accuracy and repeatability are listed in table 1-9.
Control stability is listed in table 1-10.
Performance Specification is listed in table 1-11. Procedures in table 1-11 are based on Sperry Performance Specification X4050295.

With the exception of control stability, all of the performance specifications are the same for either the measure or control modes of system operation.

To maintain a high level of confidence that the ADT-222B is performing in accordance with these specifications, adherence to a disciplined application of the performance verification and calibration procedures at the intervals prescribed in Chapter 4 is fundamental.

Display Mode	Display Units	Resolution
IN HG	P_s in. Hg	0.001 in. Hg
	P_t in. Hg	0.001 in. Hg
MILLIBARS	P_s MB	0.1 MB
	P_t MB	0.1 MB
Q_c	P_s/P_t in. Hg	0.001 in. Hg
	P_s/P_t MB	0.1 MB
ALT/AS	Altitude ft(m)	1 ft(m)
	Airspeed knots(km/hr)	0.1 knots(km/hr)

Resolution
Table 1-8

The accuracy of the ADT-222B in both the measure and control modes is basically a function of the precision vibrating diaphragm pressure sensors and is verified with a Schwien manometer to the tolerances listed in table 1-9. Repeatability and hysteresis is included in the accuracy specifications. Repeatability is also listed separately. Because of the ADT-222B 16-bit, double-precision processor, the accuracy of the computed parameters (altitude, airspeed, Q_c, and millibars) is basically a function of the pressure tolerances.

Display Units	Range/ Reference	Accuracy	Repeatability
P_S Sensor (in. Hg)	0.32 to 40.000	±0.003	±0.0015
P_t Sensor (in. Hg)	0.5 to 32.000	±0.003	±0.0015
	32 to 65.000	±0.004	±0.002
	65 to 90.000	±0.006	±0.003
	90.0 to 100.000	±0.010	±0.005
Altitude (ft)	-1,800	±3	
	10,000	±4	
	20,000	±6	
	30,000	±8	
	40,000	±12	
	50,000	±19	
	60,000	±31	
	70,000	±49	
	80,000	±80	
	90,000	±128	
	100,000	±205	
Airspeed (kts)	23	±2.2	
	50	±1.0	
	100	±0.5	
	200	±0.3	
	500	±0.2	
	1000	±0.1	
Q_C (in. Hg)	The RSS combination of applicable P_S and P_t tolerances.		

Accuracy and Repeatability
Table 1-9

Range/ References [1]	Stability [2]
0.5 to 10.000	±0.0002
20.000	±0.0003
32.000	±0.0007
45.000	±0.0012
90.000	±0.0020

[1] Units are inches of mercury.

[2] Stability changes linearly between reference points. Units are inches of mercury.

Control Stability
Table 1-10

TITLE: Performance Specification for Air Data Test System Type ADT-222B

1. SCOPE

This specification defines the performance requirements, operating features and physical configuration of the ADT-222B Air Data Test System (ADTS). The front panel controls are shown in Figure 1.

2. GENERAL DESCRIPTION

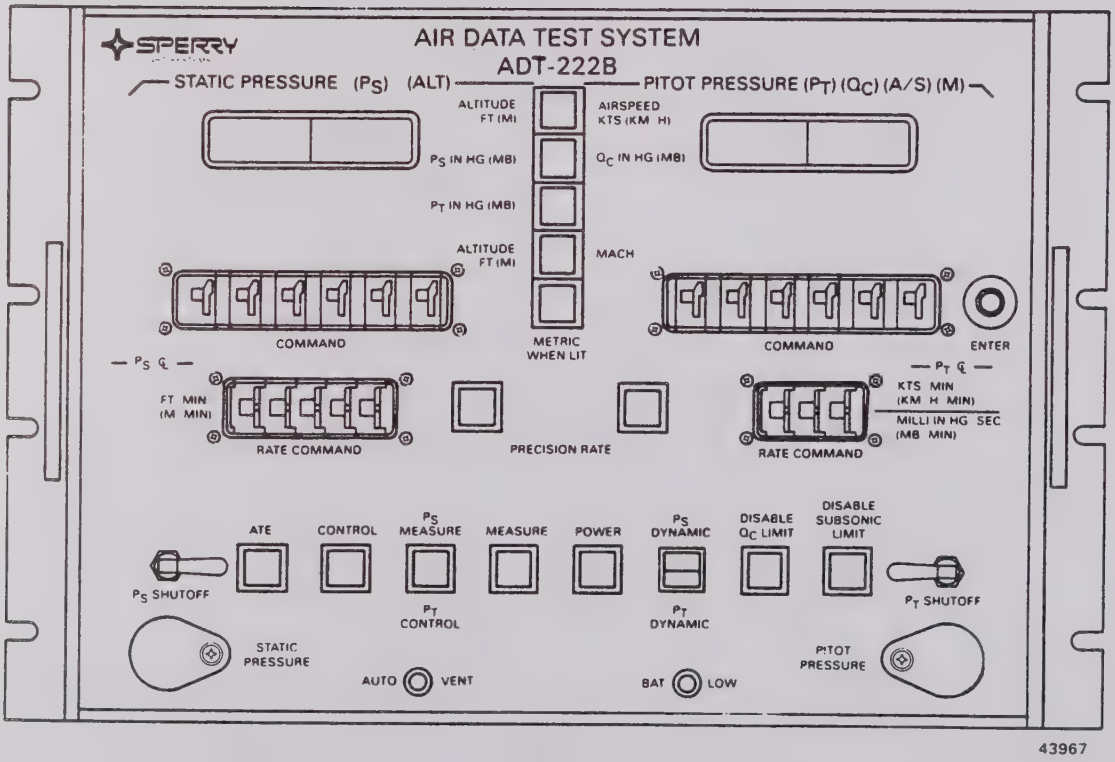
The ADT-222B Air Data Test System is a precision pressure measuring and controlling system for use in the test of air data computers and pressure sensors. It provides for both manual and automatic test operation with measurement and control of both static pressure (P_s) and pitot pressure (P_t). Pressure readouts and control input commands are presented in inches of mercury, millibars or altitude (feet or meters) and airspeed (knots or Km/H) as selected by the operator. Pressure measurement in mach number is also provided.

3. DELETED

4. REQUIREMENTS

4.1 Modes The ADT-222B provides for operations in each of four basic modes.

- o ATE
- o Control (Manual)
- o Measure
- o P_s Measure - P_t Control



ADT-222B Air Data Test System
Figure 1

The mode is selected by four pushbutton switches on the test system console.

4.1.1 ATE Mode In the ATE Mode, the ADT accepts input commands from an automatic test system and establishes output pressures and pressure rates to both pitot and static pressure ports.

4.1.2 Control Mode In the Control Mode, the ADT-222B accepts manual input commands from four sets of decimal switches and establishes output pressure and pressure rates to both pitot and static pressure ports.

4.1.3 Measure Mode In the Measure Mode, the ADT-222B will accurately measure pressure applied to both pitot and static pressure ports, but provides no pressure regulation or control.

4.1.4 P_S Measure - P_t Control Mode In this mode, the ADT-222B will accurately measure the pressure input to the P_S port while providing controlled pressure and pressure rate from the P_t port.

In this mode, a differential pressure (Q_C or V_C) may be commanded causing the P_t pressure to maintain a constant differential with respect to the measured P_S pressure. The tracking time constant is 1 second and the maximum tracking rate is 3.6 in. Hg/hour.

4.2 Display Function Requirements The ADT-222B provides display operation for both control and measurement modes in the following four functions:

- Altitude/Airspeed (feet or meters/knots or Km/H)
- P_S/Q_C (in. Hg or mB)
- P_S/P_t (in. Hg or mB)
- Altitude/Mach (feet or meters/ratio) (Measure Mode only)

4.2.1 Control Mode Range Control mode range and resolution for each of the functions are listed in Table I.

TABLE I

Function	Units	Resolution	Range*
P_S	In. Hg	.001	.500 to 32.000
	Millibars	.1	16.9 to 1083.6
P_t	In. Hg	.001	1.500 to 90.000
	Millibars	.1	50.8 to 3047.7
Q_C	In. Hg	.001	-30.500 to 89.500
	Millibars	.1	-1032.8 to 3030.8
Altitude	Feet	1	-1800 to 90,000
	Meters	1	-549 to 27,432
Airspeed	Knots	.1	32.0 to 1000.0
	Km per hr	.1	59.3 to 1852.0

*This column presents the pressure ranges over which operation is guaranteed.

4.2.2 Measure Mode Range Measure mode range and resolution for each of the functions are as listed in Table II.

TABLE II

Function	Units	Resolution	Range
P_S	In. Hg	.001	.320 to 40.000
	Millibars	.1	10.8 to 1354.6
P_t	In. Hg	.001	.500 to 100.000
	Millibars	.1	16.9 to 3386.4
Q_C	In. Hg	.001	-39.500 to 99.680
	Millibars	.1	-1337.6 to 3375.6
Altitude	Feet	1	-1800 to 100,000
	Meters	1	549 to 30,480
Airspeed	Knots	.1	23.0* to 1000.0
	Km per hr	.1	42.6* to 1852.0
Mach	Ratio	.001	.100* to 5.000

*Display range is extended to zero using a straight line. Operation in this region is indicated by the presence of an "E" in the LSD of the airspeed or Mach reading. This keeps the display "alive" for operation in these regions.

4.3 Self-Test The ADT-222B provides a self-test cycle to check proper operation of the self contained digital processor and the output displays. The Pneumatic Servo Control Valves will be shut off when self-test has been engaged. The self-test function will be selected automatically when power is turned on or if the unit detects any out-of-range condition during operation. Venting of the ADT-222B and the UUT takes place automatically during self test (see section 4.5.7, Automatic Venting).

4.4 Accuracy and Repeatability The accuracy of the ADT-222B in both the measure and control modes is basically a function of the precision vibrating diaphragm pressure sensors and is verified with a Schwien manometer to the tolerances listed in Table III. Repeatability and hysteresis is included in the accuracy specification; repeatability is also listed separately in Table III. Because of the ADT-222B's 16-bit double precision processor, the accuracy of the computed parameters (altitude, airspeed, Q_C and millibars) is only a function of the pressure tolerances. Table IV is provided for quick reference to altitude and airspeed tolerances at a few selected points.

TABLE III

Pressure Range		Repeatability	Accuracy*
P_s	.32 to 40.000 In. Hg	±.0015 In. Hg	±.003 In. Hg
P_t	.5 to 32.000 In. Hg	±.0015 In. Hg	±.003 In. Hg
	32 to 65.000 In. Hg	±.002 In. Hg	±.004 In. Hg
	65 to 90.000 In. Hg	±.003 In. Hg	±.006 In. Hg
	90 to 100.000 In. Hg	±.005 In. Hg	±.010 In. Hg

*Referenced to equipment center line.

TABLE IV (Reference)

Function		Accuracy
Altitude	-1,800 ft	± 3 ft
	10,000 ft	± 4 ft
	20,000 ft	± 6 ft
	30,000 ft	± 8 ft
	40,000 ft	± 12 ft
	50,000 ft	± 19 ft
	60,000 ft	± 31 ft
	70,000 ft	± 49 ft
	80,000 ft	± 80 ft
	90,000 ft	±128 ft
	100,000 ft	±205 ft
Airspeed	23 kts	±2.2 kts
	50 kts	±1.0 kts
	100 kts	±.5 kts
	200 kts	±.3 kts
	500 kts	±.2 kts
	1000 kts	±.1 kts

Qc The RSS combination of applicable P_s and P_t tolerances.

4.5 Control Function Performance

4.5.1 Control Stability The ADT-222B provides for continuous stable control of pressure without undesirable oscillation or hunt. Pressure control is maintained constant within the values indicated in Table V when operating from a regulated pressure source into a fixed volume of 200 cubic inches or less with system leaks of 50 milli-inches Hg/minute or less. These values are RMS values for a bandwidth of 0.1 to 1.5 Hz.

TABLE V

Function	Range	Control Stability*
In. Hg	.5 to 10 In. Hg	±.0002 In. Hg
	20 In. Hg	±.0003 In. Hg
	32 In. Hg	±.0007 In. Hg
	45 In. Hg	±.0012 In. Hg
	90 In. Hg	±.0020 In. Hg

*Increased linearly between points.

4.5.2 Displacement Rate Control The ADT-222B provides displacement rate control of static pressure (P_S) in terms of altitude rate (ft/min or meters/min), differential pressure Q_C in terms of airspeed rate (knots/min or KM/H/min), and total pressure (P_t) in terms of absolute pressure rate (milli-in. Hg/sec or mB/min). Displacement rate in normal operation is controlled by digital switches on the front panel (or commands via the interface bus in ATE control) up to a maximum of 40,000 ft/min (12190 meters/min) or 500 knots/min (926 KM/H/min) into external volumes on either channel up to 200 cubic inches for dual vacuum pump operation and up to 60 cubic inches for single vacuum pump operation. In either configuration, for smaller volumes, rates up to 65,000 ft/min (19,810 meters/min) and 700 knots/min (999 KM/H/min) can be achieved. For specific applications requiring slower rates, the ADT-222B can operate into external volumes of 1000 cubic inches or more (see section 4.5.8, Slew).

4.5.3 Control Response Pressure control will be achieved without overshoot for all pitot and static system volumes from 0 to 200 cubic inches (external). The system response time constant to digital input commands is 1.0 second.

4.5.4 Dynamic Test The ADT-222B will provide sinusoidal (or other periodic function) control of either the P_S or P_t channel using an external analog function generator. The test system will generate sinusoidal changes of P_S or P_t as required for tests specified by ARINC Characteristic 575, Paragraph 5.5 when operated into pitot or static volumes of 60 cubic inches or less. Maximum drift during dynamic test will be no greater than 0.005 in. Hg per minute. The dynamic test capability is applicable to any function.

4.5.5 Control Offset The displayed controlled pressure will not deviate from the digital command value by more than 0.0002 in. Hg.

4.5.6 Precision Rate Control Precision rate control is provided for all of the functions indicated in Paragraph 4.2. The rate units are in feet/minute or meters/min for all functions of P_S. Rate units for P_t functions are in milli-inch-Hg-second or millibars/minute or knots/minute or KM/H/min, depending on the function mode selected by the operator. Rate control will be stable and accurate within 10 seconds after rate command enters. The altitude rate accuracy is ±1.0 percent of the commanded rate or ±20 feet/minute, whichever is larger. The rate noise is less than 30 feet/minute RMS when measured through a 1-second filter. The airspeed rate accuracy is ±1 percent of commanded rate above 100 knots.

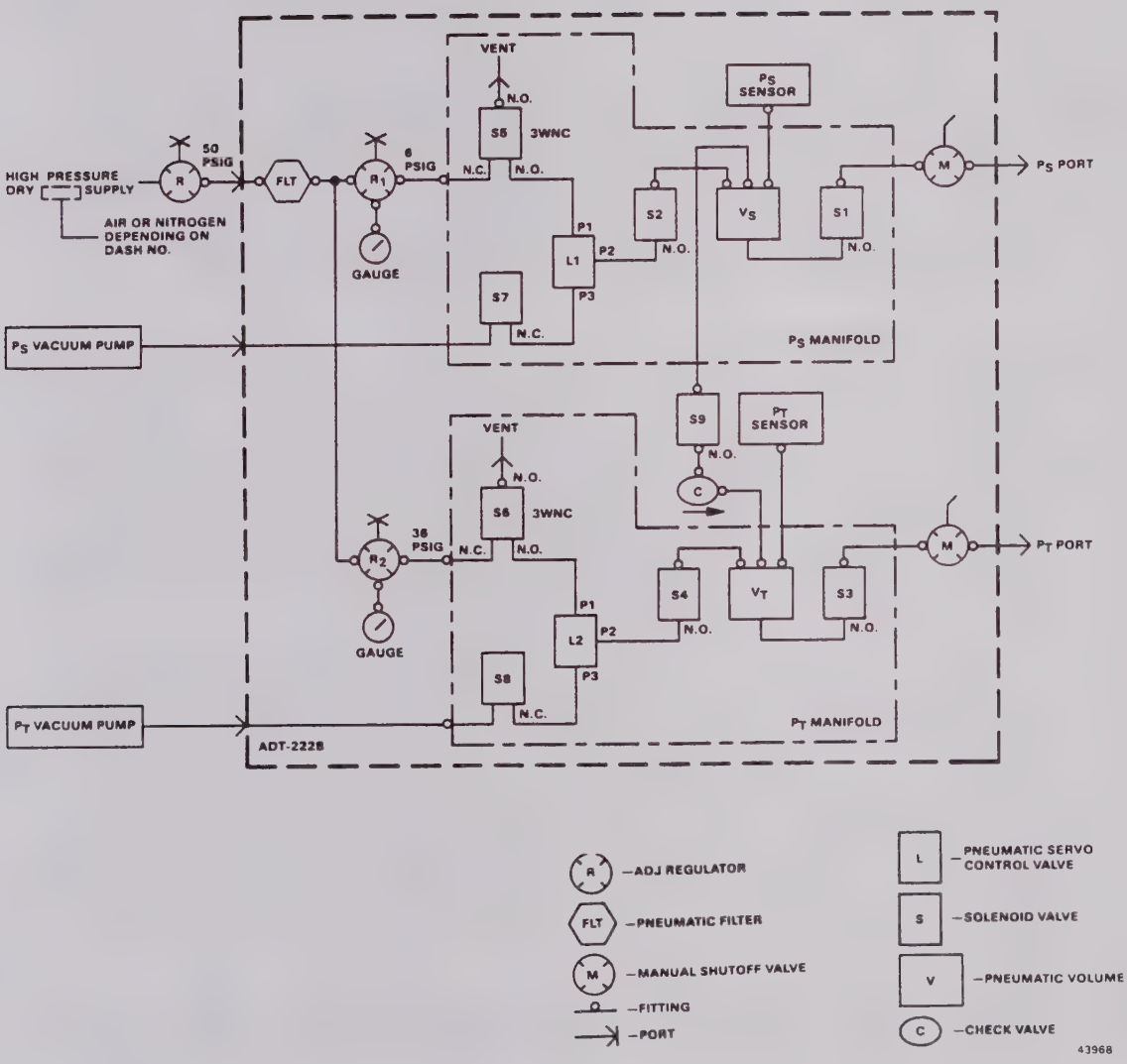
The range of precision rates is the same as the range of the displace-displacements rates and is specified in Paragraph 4.5.2.

4.5.7 Automatic Venting With no power applied or whenever the ADT-222B enters the self test mode, the ADT-222B starts its automatic venting cycle to vent to atmosphere both the ADT-222B and the UUT. Solenoid valves S1, S2, S3, S4, and S9 open and S7 and S8 close. The 3-way solenoid valves S5 and S6 close off the inlet pressure and open the vent ports. The venting rate is controlled by a fixed orfice in the control valves, L1 and L2. During venting the check valve C prevents the Q_C pressure from becoming more negative than -2 in. Hg (see Figure 2).

During venting, altitude rates are dependent on load volume and may become very small or very large. Airspeed as well as Mach number may increase by an amount sufficient to exceed the subsonic SSL/QCL flight profile envelope.

4.5.8 Slew

4.5.8.1 Automatic Slew Whenever the operator commands a large pressure rate into a large volume, the possibility exists for the control system to saturate with the control valve wide open. This is dependent not only on the commanded pressure rate, and load volume, but also on the vacuum pump and pressure pump flow capacities. The ADT-222B control system adapts to these changing conditions by entering auto slew. During auto slew, the side (P_S or P_t) that saturates continues in saturation with the control valve wide open trying to go at the commanded rate but not achieving it. The commanded rate on the opposite side is automatically reduced by the proper amount so that the transition path in the P_S, P_t and H, Vc planes are the same as if



Pneumatic Diagram
Figure 2

the saturation hadn't occurred. Thus, the transition path follows the desired path but just takes longer. This is desirable because it maintains the expected altitude (H) and Airspeed (Vc) correspondence during the transition independent of load volumes and pump capacities.

The transition path during slew will be held within ±2.0 in. Hg. of the desired path.

4.5.8.2 Commandable Slew Under certain circumstances, it is desirable to change from one pressure test station to another in the shortest possible time. The ADT-222B accomplishes this via operator command if the DSSL and DQCL lights are on. Essentially the control valve will open wide on the side (P_s, P_t) that has the largest volume. Thus the pressure on that side will move at a maximum rate. Altitude will change from 0 to 90,000 feet in approximately 30 seconds.

4.6 Safety and Interlock Provisions

4.6.1 Isolation Valves Manually operated valves are provided to isolate the P_s and P_t output ports from all internal pressure lines. In addition, two solenoid valves are provided for each pressure output. S1 and S3 are located in series with the manually operated valve; S2 and S4 are located to permit isolation of the pressure sensor from the pressure control regulator. In the measure mode with S1/S3 and the manually operated valve open and S2/S4 closed, the pressure ports (P_s and/or P_t) will be connected to the pressure sensor and isolated from the pressure control valve. (See Figure 2, Pneumatic Diagram.)

4.6.2 Power-On Interlock With no power applied, the ADT-222B starts the automatic venting process (see Section 4.5.7). When power is applied, the ADT-222B will automatically be in the self-test function mode. When a control mode is selected, valves S1 and S3 will close and the ADT-222B will automatically open S2, S4, S5, S6, S7, and S8 and adjust the control reference inputs to match the pressures measured at the input ports before opening S1 and S3, thus not exposing the unit under test to undesired pressure transients. (See Figure 2, Pneumatic Diagram.) The maximum pressure transient Measure to Control or Control to Measure) is less than ±0.020 in. Hg.

4.6.3 Pressure Control Failure If the controlled pressure exceeds the DSSL or DQCL limits set by the operator, the ADT-222B will revert to the auto venting self test mode.

4.6.4 Leak Test Operator control of S2 and S4 for system leak test will be provided in all control modes. The maximum leak rate is less than ±0.010 in. Hg per minute. System leak test may be engaged by selecting measure mode.

4.6.5 Supersonic Limits and Q_C Limits The operator may limit the pressure control range of the ADT-222B to the values given in Table VI. The Disable Subsonic Limits (DSSL) and the Disable Q_C Limit (DQCL) front panel lighted pushbuttons are used for this purpose. If the operator should inadvertently attempt to command a pressure in violation of Table VI, the proper lights will flash (DSSL or DQCL) and the control system will remain at its present pressure ignoring the command. When the operator gives a valid in range command the ADT-222B system will operate normally. These limits can be utilized in any of the four function modes indicated in Paragraph 4.2. The purpose of the DSSL and DQCL is to protect the equipment under test.

4.7 Independent Operation When operating in the manual control mode, the ADT-222B may be used for separate independent measurement and control of two absolute pressures.

4.8 ATE Operation All of the front panel manual commands can be given to the ADT-222B through the ATE connector located on the back panel. The programming, electronic logic voltages, and connector interfaces are compatible with the new ASCII IEEE "Standard Digital Interface for Programmable Instrumentation" (IEEE Std 488-1975).

4.9 Function Calibration Altitude calibration versus static pressure is defined by MIL-STD-859A. Airspeed calibration versus differential pressure is defined by MIL-STD-1524.

Front DQCL Light	Panel DSSL Light	DQCL	DSSL	P_s Limit	P_t Limit	Q_c Limit	Airspeed Limit (knots)	Altitude Limit (feet)	Altitude Rate Limit (ft/min)	Mach Limit
Off	Off	0	0	$P_s \geq 2.692$ $P_s \leq 32.019$	$P_t \geq 2.692$ $P_t \leq 47.426$	$Q_c \geq -2.016$ $Q_c \leq 15.407$	$V_c \geq .0$ $V_c \leq 525.0$	$H \geq -1888$ $H \leq 55,008$	See Note 3	$M \leq 1.1$
Off	On	0	1	$P_s \geq .480$ $P_s \leq 32.019$	$P_t \geq 1.480$ $P_t \leq 90.019$	$Q_c \geq -2.016$ $Q_c \leq 74.003$	$V_c \geq 0$ $V_c \leq 1002.6$	$H \geq -1888$ $H \leq 91,337$	65,000	$M \leq 3.5$
On	Off	1	0	$P_s \geq 2.692$ $P_s \leq 32.019$	$P_t \geq 2.692$ $P_t \leq 47.431$	$Q_c \geq -29.327$ $Q_c \leq 44.739$	$V_c \geq 0$ $V_c \leq 813.4$	$H \geq -1888$ $H \leq 55,008$	65,000	None
On	On	1	1	$P_s \geq .312$ $P_s \leq 40.003$	$P_t \geq .480$ $P_t \leq 100.019$	$Q_c \geq -39.523$ $Q_c \leq 99.707$	$V_c \geq 0$ $V_c \leq 1008.4$	$H \geq -2000$ $H \leq 100,683$	None Note 4	None

NOTES: 1. The OFF state for both DQCL and DSSL is automatically selected with power turn on.

2. See Table I for guaranteed control pressure ranges.

3. $\dot{H}$ maximum is controlled by A6 Switch 1 bits 7 and 8 per table below, when DSSL and DQCL lights are off.

Bit 7 (HDOT 2)	Bit 8 (HDOT 1)	Limit (ft/minute)
0	0	$\dot{H} \leq 65,000$
0	1	$\dot{H} \leq 20,000$
1	0	$\dot{H} \leq 10,000$
1	1	$\dot{H} \leq 6,000$

4. Commandable slew removes all rate limits to minimize time between pressure points. See Slew, Section 4.5.8.

TABLE VI

Performance Specification
Table 1-11 (cont)

5. PHYSICAL CHARACTERISTICS

5.1 Size 19 inches wide by 12-1/4 inches high by 23 inches deep.

5.2 Weight 75.8 pounds nominal (34.5 kilograms).

5.3 Power The ADT-222B requires single phase power with a safety ground. The unit may be wired internally to operate on either 115 VRMs ±10 percent (3.0 amperes maximum) or 230 VRMs ±10 percent (1.5 ampere maximum). Input power frequency to the ADT-222B may be between 45 and 440 Hz.

5.4 Pressure Fittings

P_s - Per MS 33656-6 (G)
P_t - Per MS 33656-4 (G)
Pressure Inlet Supply - Per MS 33656-4 (G)
Vacuum Inlet Supply - Per MS 33656-6 (G)

5.5 Pressure/Vacuum Source Requirements

5.5.1 Dual Vacuum Source To obtain the maximum rates driving the larger volumes, two 50-liter-per-minute free air displacement vacuum pumps are required, one for static pressure (P_s) and one for total pressure (P_t). Use of two pumps will eliminate all possibility of cross talk between P_s and P_t through the vacuum lines and thus this configuration is recommended (see Section 4.5.2).

Two Edwards Speedivac 2 vacuum pumps (or equivalent) provide the above specifications with good reliability. Unless otherwise stated, all control system performance specifications assume dual pump operation.

5.5.2 Single Vacuum Source A single 300-liter-per-minute free air displacement vacuum pump will provide good performance when the requirement for driving the maximum rates is not required. See Section 4.5.2. Two separate vacuum lines should be run from the ADT-222B and teed at the pump.

A Sargent Welch Model 1373B or equivalent is adequate.

5.5.3 Pressure Source The high pressure supply should be compressed clean and dry standard air (see P4025722) at a preregulated pressure of approximately 50 ± 5 lbs/in.^{2}) gauge pressure. The air must be free of oil vapors (less than 15 PPM Hydrocarbons) and other contaminents, therefore, oil lubricated air compressing systems should not be used. The supply air should be filtered to pass a maximum particle size of 15 microns (15 x 10^{-6} meters), and should have a maximum dew point of -50°C. Minimum flow capability of the pressure source should be 0.1 cubic foot per minute (or 2.8 liters per minute) at 50 lbs/in.^{2} (or 3.5 Kgs/cm^2) gauge pressure. This is equivalent to 2.1 lbm/hr or 0.44 SCFM. Dry nitrogen (see P695813) may be used with special calibration.

5.6 Warmup Twenty minutes nominal, 30 minutes maximum. Output displays will indicate "C" in the three least significant digits until the system has achieved warmup.

5.7 Ambient Temperature Operating Range 50 to 110 °F
10 to 43.3 °C

CHAPTER 2
INSTALLATION AND REMOVAL

CHAPTER 2
INSTALLATION AND REMOVAL

Table of Contents

Chapter-Section	Subject	Page
2-1	HANDLING AND MOUNTING	
	1. Handling	1
	2. Installation Environment	1
	3. Mounting	1
2-2	EQUIPMENT AND MATERIALS	
	1. General Requirements	1
	2. Power Connector	2
	3. Pressure Supply	2
	4. Vacuum Source	3
	5. Displacement Rate Control	6
	6. Control Interfaces	6
2-3	INSTALLATION PROCEDURE	
2-4	INSTALLATION VERIFICATION	
	1. Measure Mode	1
	2. Control Mode	2
2-5	REMOVAL FROM SERVICE	
2-6	STORAGE AND SHIPPING	
	1. Storage	1
	2. Equipment and Materials	1
	3. Preparation for Shipping	3

Section 1. Handling and Mounting

1. Handling

Do not pick up the ADT-222B by the handles on the front panel. The handles have been supplied for purposes of pulling the unit out of an equipment rack when it has been mounted in an equipment drawer or on guide rails. Use handles on sides of ADT-222B when picking up unit.

There are no other special handling procedures for the ADT-222B. Although the ADT-222B is ruggedly constructed and has no components requiring delicate handling, it is a piece of precision test equipment and shall be handled carefully and with respect. It can be damaged by dropping.

2. Installation Environment

The ADT-222B has been designed to be used in an environment with an altitude of less than 6000 feet above sea level. It may be used at higher elevations provided that a sufficient flow of cooling air is supplied to keep its operating temperature below 110 degrees fahrenheit and the inlet pressure supply is capable of providing adequate volume and regulation to provide a flow of at least 0.1 cubic feet per minute (2.8 liters per minute) at a pressure of 65 $\pm$ 5 pounds per square inch absolute. The two internal pressure regulators may have to be reset. (Refer to Chapter 4, section 5 for resetting procedure.)

3. Mounting

The ADT-222B shall be installed so that it is within 2 degrees or less of being level on a bench top, equipment rack, or other mounting that is relatively free of vibration. It shall not share a mounting with the vacuum pumps.

The ADT-222B must not be mounted in a way that would restrict the air flow around its enclosure or block the exhaust air of the cooling fan.

CAUTION: DO NOT MOUNT THE ADT-222B SO THAT IT IS SUPPORTED BY THE EXTENDED FRONT PANEL ONLY. THE UNIT MUST ALSO REST ON SOME TYPE OF SHELF, DRAWER, OR RAIL MOUNTING.

Section 2. Equipment and Materials

1. General Requirements

Equipment and materials required for installation of the ADT-222B, but not supplied with the ADT-222B, are identified below and discussed in detail in paragraphs 2 thru 6.

Power connector plug - Three-prong, commercial (paragraph 2)

Pressure hose - Commercial (paragraph 3)

Pressure pump - Model PFP-10-2-81, Porters Fluid Power Inc, Phoenix, AZ

Inlet supply of dry air or dry nitrogen at 50 ± 5 psig (65 ± 5 psi absolute)

Anti-oil suck back trap(s) - Locally fabricated (paragraph 3)

Vacuum hose (two 10-foot maximum lengths) - Metal tubing, 0.375 inch ID and 0.875 inch OD (Flexible hose designed for vacuum applications and with 0.375 inch ID minimum is acceptable.)

Vacuum pumps (paragraph 4)

Dual pump configuration

54 Liters per Minute (1.75 cfm) - Edwards Speedivac 2 with oil mist filter Model OMF2/ORF2, El Segundo, CA

50 Liters per Minute - Single stage, Model 8806, Sargent Welch Scientific Co, Skokie, IL

Single pump configuration

300 Liters per Minute - Model 1373B or 1373L, Sargent Welch Scientific Co

334 Liters per Minute (11.7 cfm) - Single stage, Model ES330(C), Edwards High Vacuum Inc, Grand Island, NY

320 Liters per Minute (11.2 cfm) - Single stage, Model D-330, Dynavac PTY LTD, Burwood Victoria, Australia

280 Liters per Minute (9.8 cfm) - Single stage, Model Hyvac 28S, Central Scientific Co Inc, Chicago, IL

Exhaust filter(s) - For the vacuum pump(s)

Waveform generator - Wavetek Model 154

2. Power Connector

CAUTION: DO NOT OPERATE WITHOUT A SAFETY GROUND.

The power required by the ADT-222B, as defined by the dash number, is 115/230 volts (-2X1, -2X3, -4X1, and -4X3 operate on 115 volts; -2X2, -2X4, -4X2, and -4X4 operate on 230 volts), 45 to 440 Hz, single-phase. Operation of the system requires the connection of a safety ground. Since there is no standardized single-phase plug with a safety ground, no power plug is supplied with the ADT-222B. The user must supply a power connector plug to match the electrical wiring of the installation site.

3. Pressure Supply

The inlet supply shall be compressed, clean, dry, standard (ambient) air (for -2X1, -2X2, 4X1, and 4X2 series) or dry nitrogen (for -2X3, -2X4, -4X3, and -4X4 series) at a pre-regulated pressure of approximately 50 $\pm$ 5 lbs/in^2 (or 3.5 kgs/cm^2) gauge pressure. The air must be free of oil vapors and other contaminants, therefore oil lubricated air compressing systems should not be used. The supply air shall be filtered to pass a maximum particle size of 15 microns (15 x 10^{-6} meters), and shall have a maximum dew point of -50 °C. Minimum flow capability of the pressure source shall be 0.44 standard cubic foot per minute (2.1 pounds mass per hour). Dry nitrogen may be used with special calibration. A decal located just under green power pushbutton on the front panel indicates that the unit has been calibrated for either dry air or dry nitrogen. If the supply is not capable of $\pm$5 psig regulation, it will be necessary to add a good quality two-stage commercial regulator capable of maintaining a pressure of 50 $\pm$ 5 psig.

The P_{in} connector on the rear panel of the ADT-222B is a 1/4-inch 37-1/2 degree male flare fitting (MS-33656-4). The pressure hose must have a pressure fitting designed to mate with this connector.

4. Vacuum Source

CAUTION: DO NOT OPERATE WITHOUT ANTI-OIL SUCK-BACK PROTECTION.

Two vacuum ports are provided, one for static pressure (P_s) and one for total (P_t). The ADT-222B will operate with a single vacuum source connected to both ports or with separate vacuum supplies.

The vacuum pump(s) must be equipped with exhaust filter(s) and filter elements. Running the pump(s) without an exhaust filter does not damage the pump(s) or the ADT-222B, but the pump(s) blow out some oil vapor that would normally be condensed by the filter and returned to the pump. The pump also makes much more noise without the filter. If pumps are purchased from an alternate manufacturer, ensure that the appropriate exhaust filter(s) are also obtainable from this same source.

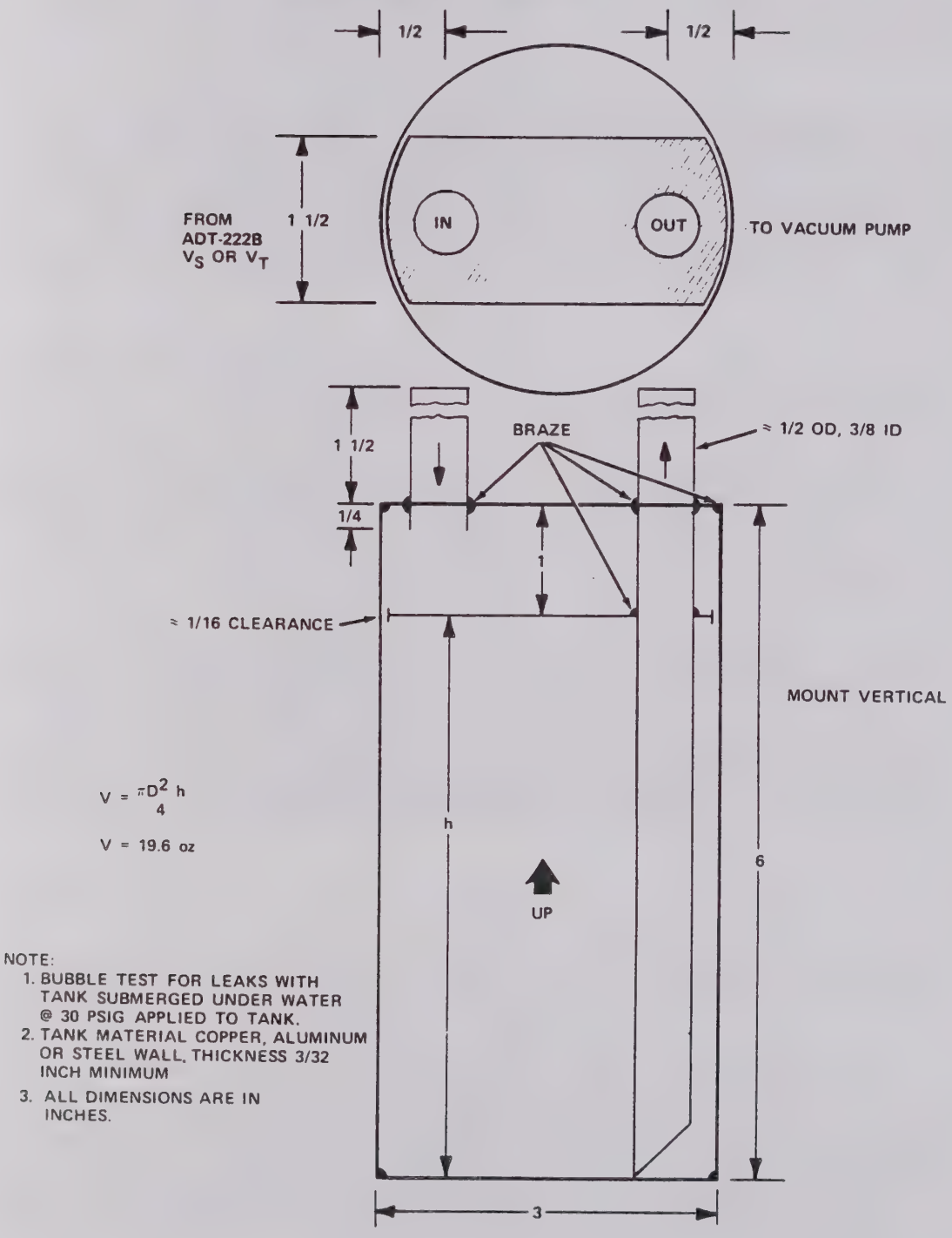
An oil drip pan shall be placed under each vacuum pump, because some oil vapor eventually gets past the filter and condenses on the outside of the pump.

Because of differences in manufacturers, some vacuum pump models have better anti-oil suck back protection capability than others whenever pump power is lost. Therefore, it is recommended when purchasing vacuum pump(s) that a manufacturer's guarantee, to the effect that "the pump will not allow oil to be sucked back into the vacuum system" is obtained. If such a guarantee is not obtainable and/or confidence in the pump capability/reliability is in question, it is further recommended that an oil trap (figure 2-1) be fabricated and installed. The trap is a simple, self-cleaning oil trap mounted vertically (figure 2-2) in each vacuum line.

Although manufactured traps may be purchased, caution must be exercised to ensure that the resistance to air flow is not any greater than that caused by two feet of 3/8-inch ID vacuum line.

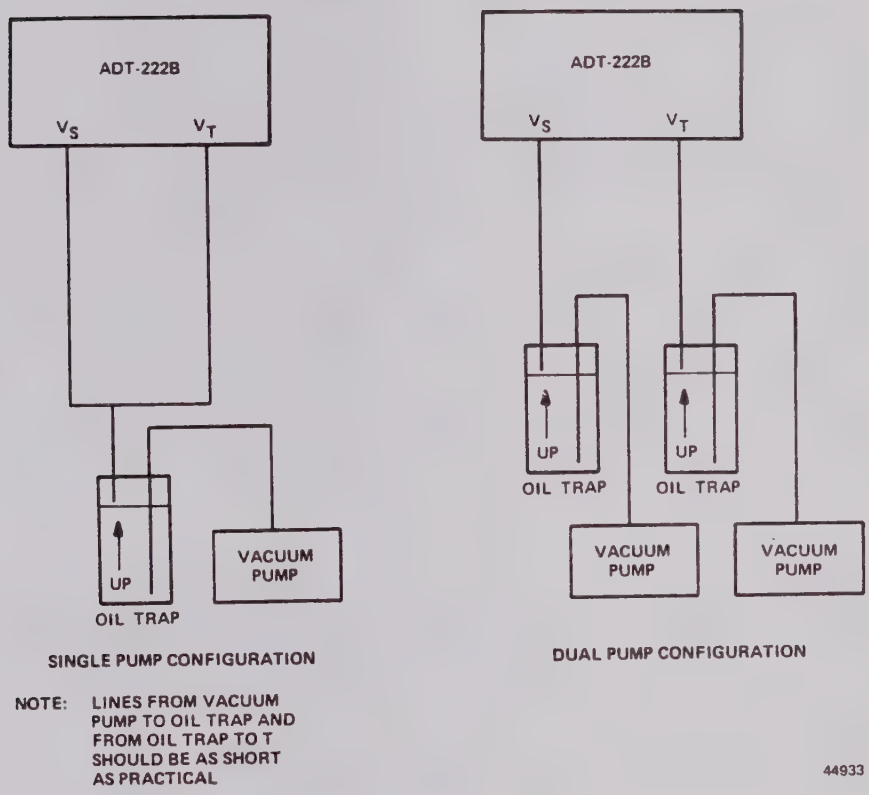
The vacuum pump(s) may be left on 24 hours a day. If the ADT-222B is not being used, it should be placed in the measure mode with the front panel shut off valves open to the atmosphere. Place the caps (hanging on the chains) loosely over the P_s and P_t panel pneumatic fittings. In the measure mode, there is no consumption of inlet air and thus no air flow (load) through the vacuum pumps.

The vacuum connectors on the rear panel of the ADT-222B, V_s and V_t, are 3/8-inch 37-1/2 degree male flare fittings (MS-33656-6). The vacuum hoses must have pressure fittings designed to mate with these connectors. Use only lines that are designed for vacuum, because other types of pneumatic hose collapse under vacuum and cause a restriction in the vacuum line. Each of these lines must have a minimum of 3/8-inch inside diameter and a length of 10 feet maximum. Any valve or filter inserted in these lines must have this equivalent cross section so it does not create a restriction.



NOTE:
1. BUBBLE TEST FOR LEAKS WITH TANK SUBMERGED UNDER WATER @ 30 PSIG APPLIED TO TANK.
2. TANK MATERIAL COPPER, ALUMINUM OR STEEL WALL, THICKNESS 3/32 INCH MINIMUM
3. ALL DIMENSIONS ARE IN INCHES.

Oil Trap Fabrication Layout
Figure 2-1



Typical Oil Trap Interface
Figure 2-2

4. A. Dual Vacuum Source

Utilizing two 50-liter-per-minute free air displacement vacuum pumps provides the capability to drive the larger ADT-222B volumes at the maximum rates. Use of two pumps also eliminates all possibility of cross talk between P_S and P_t through the vacuum lines. One pump is connected to the P_S port and one to the P_t port.

B. Single Vacuum Source

One 300-liter-per-minute free air displacement vacuum pump provides good performance when it is not required to drive the maximum volumes at the maximum rates. Two separate vacuum lines should be run from the ADT-222B and T'd at the pump. The lines from the vacuum pump to the oil trap and from the oil trap to the T should be as short as possible.

5. Displacement Rate Control

The ADT-222B provides displacement rate control of static pressure (P_s) in terms of altitude rate (feet per minute or meters per minute), differential pressure Q_c in terms of airspeed rate (knots per minute or KM/H per minute), and total pressure (P_t) in terms of absolute pressure rate (milli-in. Hg per second or mB per minute). Displacement rate in normal operation is controlled by digital switches on the front panel (or commands via the interface bus in ATE control) up to a maximum of 40,000 feet per minute (12,190 meters per minute) or 500 knots per minute (926 KM/H per minute) into external volumes on either channel up to 200 cubic inches for dual vacuum pump operation and up to 60 cubic inches for single vacuum pump operation. For smaller volumes in either configuration, rates up to 65,000 feet per minute (19,810 meters per minute) and 700 knots per minute (999 KM/H per minute) can be achieved. For specific applications requiring slower rates, the ADT-222B can operate into external volumes of 500 cubic inches or more.

6. Control Interfaces

If the dynamic input capability of the ADT-222B is to be used, a waveform generator, Wavetek Model 154, or equivalent, should be connected to DYNAMIC INPUT connector J2-B (lo) and J2-A on the rear panel of the ADT-222B. This connector is Bendix Part No. JTP02RE8-35 and mates with Bendix Part No. JT06RE8-98P(SR) connector.

NOTE: Facing the connector, pin J2-A is to the left of the keying slot and pin J2-B is directly below the slot.

If the ADT-222B is to be operated by an ATE or from a programmable terminal, the controlling equipment must be compatible with the IEEE Standard 488-1975 interface and connected to the rectangular ATE IEEE-488 connector on the rear panel of the ADT-222B. This connector is Bendix Part No. JTP02RE14-35S and mates with Bendix Part No. JT06RE14-35P(SR) connector. (Refer to Chapter 3 for instructions applicable to ATE operation.)

Section 3. Installation Procedure

NOTE: Installation procedures for the optional ATE interface are contained in Chapter 3.

1. Do not break the seal on the top or bottom cover of the ADT-222B.

2. Do not adjust the pressure regulators on the back panel of the ADT-222B.

CAUTION: DO NOT MOUNT THE ADT-222B SO THAT IT IS SUPPORTED BY THE EXTENDED FRONT PANEL ONLY. THE UNIT MUST ALSO REST ON SOME TYPE OF SHELF, DRAWER, OR RAIL MOUNTING.

3. If the ADT-222B is to be rack-mounted, mount it in a standard EIA 19-inch rack. Alternatively, the ADT-222B can rest on a bench top.

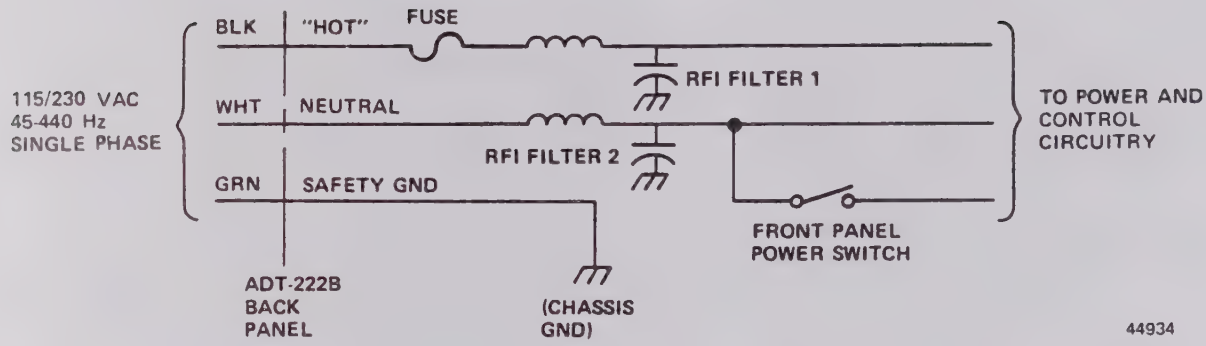
CAUTION: REFER TO THE ADT-222B CONFIGURATIONS TABLE IN THE FOREWORD FOR VOLTAGE SOURCE FOR EACH SPECIFIC PART NUMBER. OPERATING VOLTAGE IS INDICATED ON REAR PANEL INSTRUCTION PLATE.

4. Install a power plug consistent with your electrical wiring. A power plug installation schematic is shown in figure 2-3. A 115/230 volt rms, 45 to 440 Hz, single-phase plug with a safety ground is required. (The ADT-222B (-XX2, -XX4) does not come with a plug because there is no standardized single-phase plug with a safety ground for 230-volt operation.)

INSTALLATION CRITICAL

The following step fulfills the INSTALLATION CRITICAL requirement to prevent electrical shock by ensuring that continuity exists between chassis and chassis ground wire at plug end of power cable.

5. Measure for resistance of less than 1 ohm between ADT-222B chassis and chassis ground wire at plug end of power cable. Connection of this green safety ground to the chassis ground is mandatory. The green wire must also be connected to a good earth ground. Approximately 10 to 100 milliamperes flows through RFI filter 1 and the green safety wire.



Power Connection Schematic
Figure 2-3

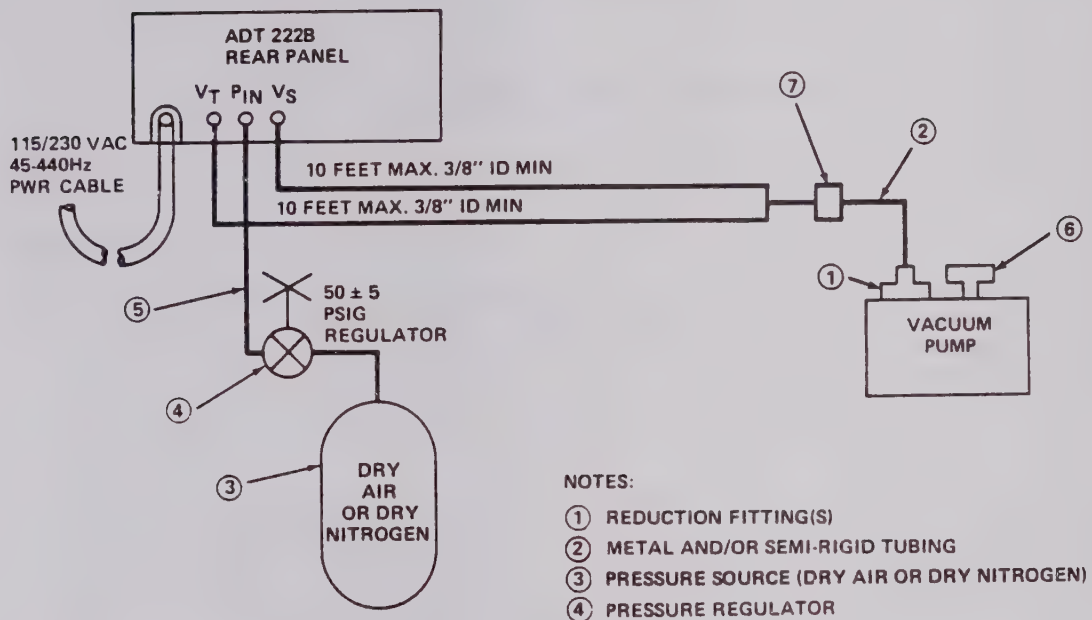
6. Connect a 50 ± 5 psig inlet supply of dry air or dry nitrogen to the P_{in} (1/4-inch 37-1/2 degree MS-33656-4) male flare fitting on the back panel of the ADT-222B. (See figure 2-4.) A decal located just under the front panel green power pushbutton indicates that the unit has been calibrated for either dry air or dry nitrogen. Also, the dash number of the ADT-222B defines the medium for which the unit has to be calibrated. (Refer to FOREWORD table.)

7. Connect vacuum pump(s) to the V_s and V_t pneumatic fittings on the back panel of the ADT-222B. These back panel vacuum fittings are 3/8-inch 37-1/2 degree (MS-33656-6) male flare. Use 3/8-inch inside diameter vacuum line up to 10 feet long. Longer lines may be used if the inside diameter is increased. The following equation may be used to calculate the required minimum inside diameter for line lengths longer than 10 feet.

$$D \geq \left(\frac{L}{505}\right)^{\frac{1}{4}}$$

D = ID in inches
L = Length in feet

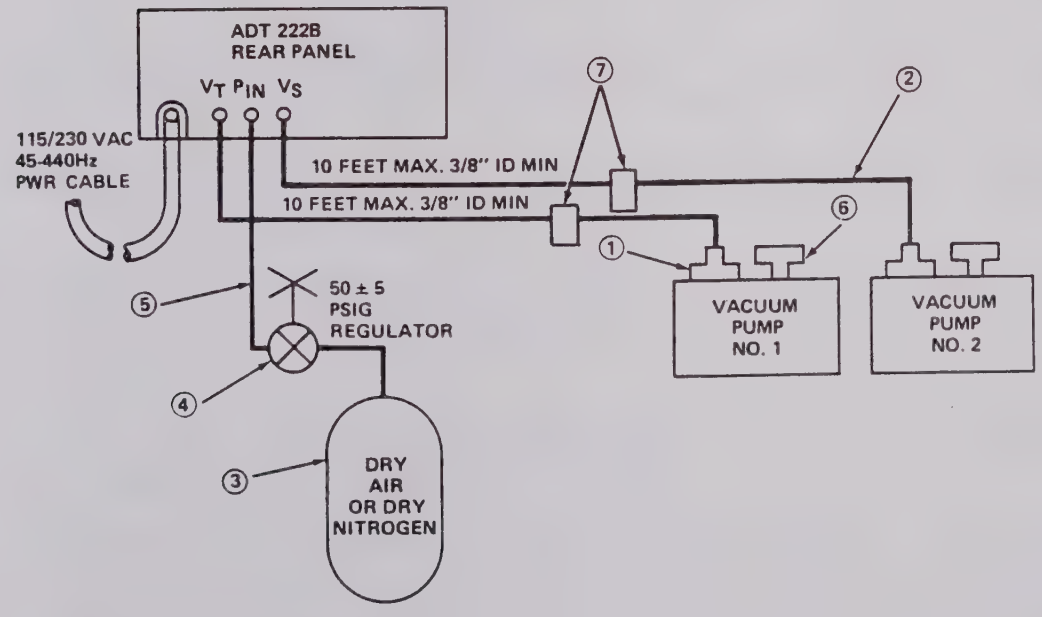
8. Connect the ADT-222B to the power source, but do not turn it on yet. You are now ready to perform the installation verification procedure.



SINGLE PUMP CONFIGURATION

NOTES:

1. REDUCTION FITTING(S)
2. METAL AND/OR SEMI-RIGID TUBING
3. PRESSURE SOURCE (DRY AIR OR DRY NITROGEN)
4. PRESSURE REGULATOR
5. PRESSURE HOSE
6. EXHAUST FILTER
7. OIL ANTI SUCK BACK TRAPS



DUAL PUMP CONFIGURATION

44935

Pneumatic Connection Schematic
Figure 2-4

Section 4. Installation Verification

NOTE: Before operating the ADT-222B, read Chapter 1.

1. Measure Mode

A. Press the POWER pushbutton on the ADT-222B front panel to turn on power. The green light should light. The ADT-222B will begin its self test routine. Self test starts by flashing the lights on the front panel five times so the operator may check for a defective lamp. Some lights may stay on and not flash, some lights may flash at different rates; however, all lamps plus COMMAND switch decimal points should light.

After the five cycle light flashing sequence is finished, the ADT-222B cycles the displays through 0, 1, 2, ... A, blank, C, -d, E, F etc. until the operator selects the units he wants to use (i.e., presses one of the four vertical pushbuttons: ALTITUDE FT(M)/AIRSPEED KTS (KM/H); P_S IN HG (MB)/Q_C IN HG (MB); P_S IN HG (MB)/P_t IN HG (MB); ALTITUDE FT (M)/MACH). If the self test fails, the ADT-222B just continues to flash the front panel lights and does not allow the operator to select the desired measurement units.

B. Open the P_S and P_t front panel manual shutoff valves (pull) and remove the caps from the P_S and P_t pneumatic fittings.

C. Press one of the four display mode pushbuttons. For the following example, push P_S IN HG (MB)/P_t IN HG (MB). The ADT-222B enters the measure mode and you hear the solenoid valves open.

The warmup cycle takes between 15 and 30 minutes. During this time, both displays indicate CCC in the three right-hand digits. When the warmup cycle is complete, the displays cease to indicate CCC.

The ADT-222B is in the measure mode measuring the static pressure input in inches of Hg and the pitot pressure input in inches of Hg. Both the P_S and P_t displays measure the local atmospheric pressure in inches of Hg absolute.

Any pressure within the measurement range of the ADT-222B may now be connected to the P_S and P_t ports and measured accurately. The measurement ranges are listed in Chapter 1, section 3.

By pressing any of the other three vertical pushbuttons, the measurement of these input pressures may be read directly in units of millibars, meters, kilometers/hour, feet, knots, or mach. Press METRIC WHEN LIT pushbutton to change readout to metric units. Press again to return to English units.

2. Control Mode

A. Turn on the 50 psig air (or nitrogen) supply. Verify that the pressure at the back panel is 50 ± 5 psig.

B. Turn on vacuum pump(s).

C. Turn on the ADT-222B power and put the ADT-222B in the measure mode with P_S/P_t inches of Hg displayed (as described previously).

D. Open the P_S and P_t shutoff valves and remove the caps, thus venting the P_S and P_t measurement systems to the atmosphere.

NOTE: Normally with the ADT-222B in this state, a unit to be tested (UUT) would be connected to the P_S and P_t front panel pneumatic fittings for -2XX units, and -4XX units for rear panel pneumatic fittings. The state of the DISABLE Q_C LIMIT (DQCL) and the DISABLE SUBSONIC LIMIT (DSSL) should already be set. These limits are intended to protect the UUT from an improper command and should be set prior to connecting the UUT to the ADT-222B. Once the state of these limits are set, do not push them until the UUT has been removed from the ADT-222B. Even if the lights flash, don't push them, because this will change the protection limits and allow the ADT-222B to accept a UUT over range command. Also, once a UUT has been connected to the ADT-222B, do not close the manual shutoff valves unless an "FFF" appears in the display.

E. Until you are familiar with the operation of the ADT-222B, do not connect a UUT, but instead close both the P_S and P_t front panel manual shutoff valves.

F. Press the CONTROL pushbutton. The CONTROL button lights. Verify that the inlet pressure at the rear panel is still 50 ± 5 psig.

The vacuum pump(s) now sound louder, especially if no exhaust filter has been installed. This is normal.

As soon as you press CONTROL, the ADT-222B pneumatically disconnects itself from the UUT and begins to initialize its control system pressure to the pressure being measured just prior to pressing the CONTROL pushbutton. This sequence takes about 15 seconds. When it has completed, the ADT-222B pneumatically reconnects itself to the UUT and the sound of a solenoid operating inside the ADT-222B is heard.

2. G. Dial the P_S/P_t COMMAND switches to:

P_S = 30.000 in. Hg
P_t = 30.000 in. Hg

P_S Rate to 10000 feet per minute
P_t Rate to 200 milli-in. Hg per second

NOTE: The lighted decimal point in the COMMAND switches traces the display decimal point. The rate decimal point is always on the extreme right.

H. Press the ENTER pushbutton. The ADT-222B controls the P_S and P_t pressure from your local ambient pressure to 30.000 inches Hg at 10,000 feet per minute and 200 milli-in. Hg per second, respectively, if the ADT-222B is connected correctly, and, if for both measure and control states, the P_{in} pressure at the ADT-222B back panel is 50.0 ± 5 psig. If this pressure is not regulated properly in the measure mode, the ADT-222B may not open a pneumatic solenoid and allow this inlet pressure to reach the internal control system. Thus, the control system will not operate.

If the BDT-222A does not command to 30.000 inches Hg, or if there is an "E" in either display (30.00E), the system has detected a failure. Recheck installation.

I. After both displays reach 30.000 in. Hg, dial these new commands.

P_S = 000.500 in. Hg
P_t = 001.500 in. Hg
P_S rate = 30,000 feet per minute
P_t rate = 300 milli-in. Hg per second

J. Press the DISABLE Q_C LIMIT and DISABLE SUBSONIC LIMIT pushbuttons to turn on their lights.

K. Press ENTER. The P_S and P_t displays shall control to P_S = 0.500 in. Hg and P_t = 1.500 in. Hg. If either display does not reach the commanded value, a steady "E" appears in the display. This steady "E" means that something is wrong, probably a leak in the vacuum line between the back panel and the vacuum pump(s), or there may be a restriction in the vacuum lines.

These lines must be a minimum of 3/8-inch ID throughout their entire length (10 feet maximum). Any valve or filter installed in these lines must have this effective size; otherwise, a pressure drop will occur at the restriction. If you are not using tubing designed for vacuum, you may have a collapsed hose.

2. L. If the ADT-222B displays go to the commanded pressures, dial in these new commands.

P_s = 32.000 in. Hg
P_t = 90.000 in. Hg

M. Press ENTER. If the displays do not reach the commanded values, a steady "E" appears in the display. If this happens, check the P_{in} inlet pressure for 50 psig regulation.

N. Press MEASURE, then press P_s MEASURE/P_t CONTROL pushbutton; button shall light, indicating ADT-222B is in split channel mode.

O. Press ENTER. If P_t display does not reach commanded values, a steady "E" appears in the display. If display responds properly, P_t shall indicate last pressure commanded.

If these tests pass, your ADT-222B is installed and operating properly. Please continue operating the front panel controls to become familiar with their operation. Commands may be given directly in any of the measurement units. Wait until the pressures reach the last commanded values and try different units.

NOTE: If for any reason you wish to rapidly stop the pressure command, press the MEASURE pushbutton. This immediately disconnects the ADT-222B control system from the UUT and stops the pressure changes.

Section 5. Removal from Service

For accuracy and stability, the ADT-222B should not be turned off and the vacuum pump(s) may be left on 24 hours a day. If the ADT-222B is not being used, it should be left in the measure mode with the P_s and P_t shutoff valves open to the atmosphere. Place the caps, hanging on the chains, loosely over the P_s and P_t input ports. In the measure mode, there is no consumption of inlet air and no air flow through the pumps.

If you desire to shut off the vacuum pump(s) or turn off the ADT-222B, perform the following shutdown procedure:

1. Press the P_s IN HG (MB)/P_tIN HG (MB) pushbutton.
2. Close the P_s SHUTOFF and P_t SHUTOFF valves.
3. Press the CONTROL pushbutton.
4. Set both sets of the COMMAND select switches to 020000.
5. Set Rate Command switches to 90,000 ft/min and 900 milli-in Hg/sec.
6. Press the ENTER pushbutton.
7. When both displays have reached "20.000", turn off both vacuum pumps.
8. When a steady "E" appears in both displays, open the P_s SHUTOFF and P_t SHUTOFF valves to vent the ADT-222B to the atmosphere.
9. Wait 15 seconds.
10. Place the port caps loosely over the P_s and P_t ports.
11. Press the MEASURE pushbutton.
12. Press the POWER pushbutton to turn off the ADT-222B.

The above procedure relieves the high vacuum in the vacuum lines and removes any possibility of vacuum pump oil diffusing into the ADT-222B pneumatic system. The ADT-222B can now be disconnected from the electrical, pressure, vacuum, and control sources, and removed from its mounting.

Section 6. Storage and Shipping

1. Storage

If the ADT-222B is to be removed from service and stored for long periods of time, it must be protected from dust, moisture, and other contaminants. The best way to provide this protection is to package the ADT-222B for shipment before storage. The original shipping materials are reusable and should be saved for this purpose.

Sperry Flight Systems' warranty responsibility is contingent upon the use of the procedures, equipment, and materials specified for the handling, storage, and preparation for shipment of the ADT-222B.

2. Equipment and Materials

Polyethylene wrapping, 6 by 6 feet (1.83 by 1.83 m)

Expanded polystyrene bead board (two pieces), 29.25 by 12.25 by 2 inches (74.3 by 27.5 by 5.1 cm) with a 0.125 inch (0.3 cm) wide by 0.75 inch (1.9 cm) deep groove cut across the 29.25 by 12.25 inch (74.3 by 27.5 cm) face. The groove is parallel to, and 3 inches (7.6 cm) from, the 12.25 inch (27.5 cm) side. (See figure 2-5, detail A.)

Expanded polystyrene bead board (two pieces), 29.25 by 12.25 by 0.5 inches (74.3 by 27.5 by 1.3 cm)

Inner container, 29.25 by 23.0 by 12.25 inches (74.3 by 58.4 by 27.5 cm) high, double covered carton sleeve with end caps to fit

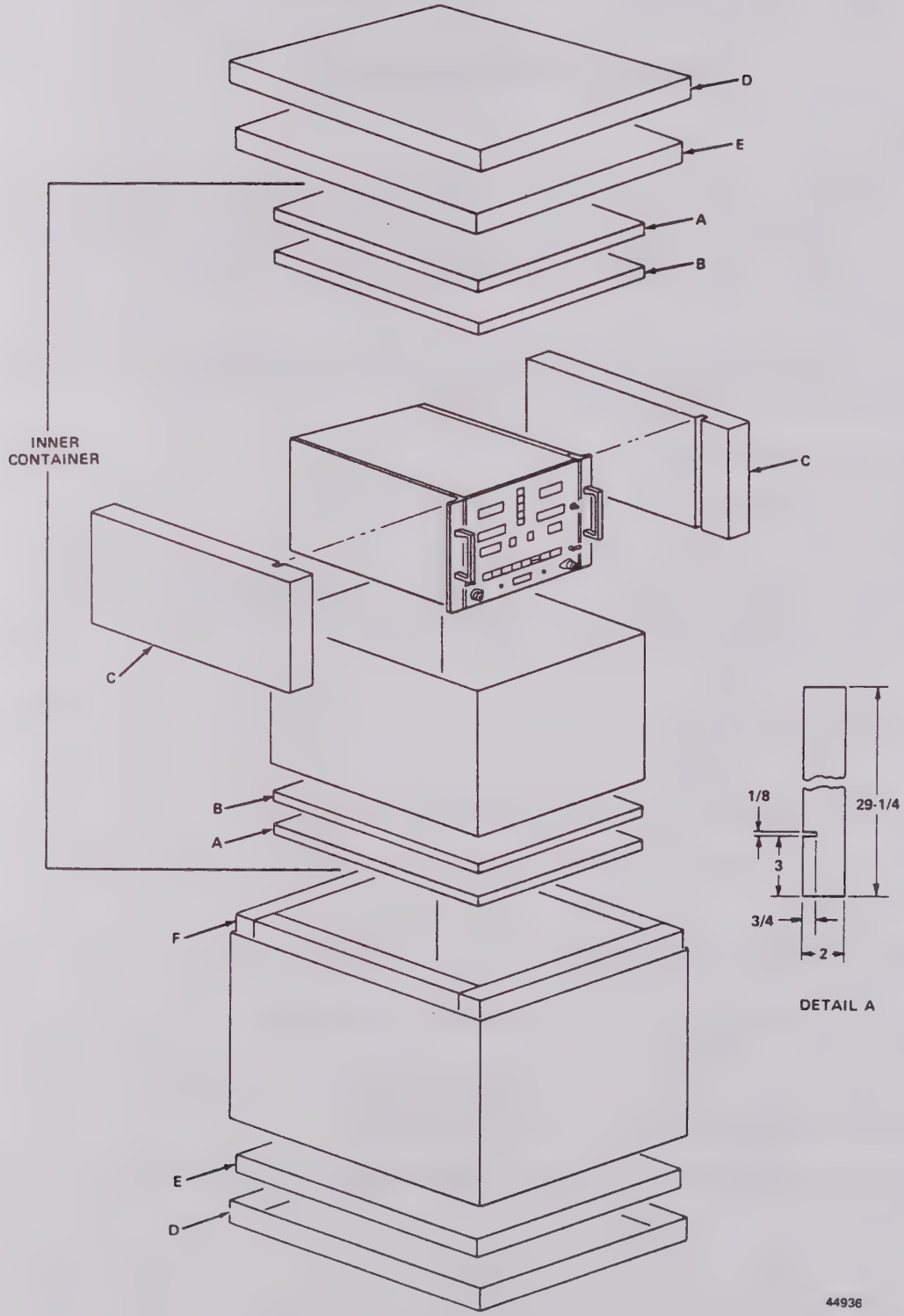
Barrier bag, 46.5 by 60 inches (118.1 by 152.4 cm) (Required for overseas shipment only.)

Uncompressed bound fiber cushioning material (two pieces), 23 by 12.25 by 3 inches (58.4 by 31.1 by 7.6 cm)

Uncompressed bound fiber cushioning material (two pieces), 35 by 29 by 3 inches (88.9 by 73.7 by 7.6 cm)

Outer container, 35.25 by 29 by 17 inches (89.5 by 73.7 by 43.2 cm) high, double covered carton sleeve with end caps to fit

Strapping, 3/8-inch (0.9 cm) plastic, with required strapping tool



ADT-222B Storage and Shipping Container
Figure 2-5

3. Preparation for Shipping

A. Place inner container sleeve, open end up, in one of the end caps (A, figure 2-5). Place one piece of polystyrene bead board (B) on end cap inside sleeve.

B. Important: Close both manual shutoff valves on the ADT-222B and cover all connectors and pneumatic fittings with attached caps.

C. Wrap ADT-222B in polyethylene wrapping. Place polystyrene bead board (C) on ADT-222B so that protruding edges of front panel fit into grooves in polystyrene.

D. Place ADT-222B and polystyrene into inner container sleeve with power cable in area at rear of ADT-222B.

E. Place remaining piece of polystyrene on top of the ADT-222B and cover with remaining end cap. Sleeve end caps in place with two strapping bands.

F. Place inner container in barrier bag, exhaust air from bag, and heat seal open end of bag. (This step is required only for overseas shipment.)

G. Place outer container sleeve in one of the end caps (D). Place cushioning material (E, F) at bottom and all sides of this container.

H. Place inner container into outer container within cushioning material. Place remaining cushioning material on top of inner container and cover with remaining end cap. Secure end caps with two to four strapping bands.

I. Mark container to identify contents and date of packaging.

CHAPTER 3
AUTOMATIC OPERATION

CHAPTER 3
AUTOMATIC OPERATION

Table of Contents

Chapter-Section	Subject	Page
3-1	DESCRIPTION	
	1. General	1
	2. Functional Operation	1
3-2	OPERATING PROCEDURES	
	1. Introduction	1
	2. Procedure	1
3-3	INSTALLATION/CHECKOUT	
	1. General Requirements	1
	2. Peripheral Requirements	1
	3. Installation Procedure	1
	4. Checkout Procedure	4
3-4	PROGRAMMING INSTRUCTIONS	
	1. General	1
	2. Interface Address	1
	3. Program Instructions and Data Formats	2
	4. Conversations	16
	5. Programming Constraints	17
	6. ASCII Flags	19
3-5	MAINTENANCE	
	1. General	1
	2. Procedure	1

Section 1. Description

1. General

Automatic operation of the ADT-222B is available either through the addition of the ASCII interface option, Part No. 4028446-901, or by obtaining ADT-222B, Part No. 4047505-22X, -42X, which has the option installed by Sperry during manufacture.

The option, Part No. 4028446-901, consists of an ASCII interface circuit card assembly A10, Part No. 4027467-901. The ASCII interface option provides the capability of operating the ADT-222B under the control of any ATE system or other control system compatible with ASCII standard digital interface for programmable instrumentation in accordance with IEEE standard 488-1975. The option allows all of the front panel manual commands to be given to the ADT-222B through either of the rear panel ATE connectors (except turning power on or putting unit into ATE control). (Refer to table 3-1.) A copy of IEEE standard 488-1975 may be ordered from:

IEEE Standards Office
415 E. 47th St.
New York, N.Y. 10017

2. Functional Description

A block diagram for the ASCII interface circuit card is shown in figure 3-1. The functions associated with the ASCII bus (ATE) interface are on the right side of the diagram and the functions associated with the processor interface control functions are on the left.

Data is received from, and transmitted to, the ATE by the ASCII bus transceivers. Input commands from the ATE are decoded by the address decoder and control function. A conversation between the ATE and the ADT-222B is established by a LISTEN or TALK command to the ADT-222B over the ASCII bus. A LISTEN command is followed by input data from the ATE. Each input data word is preceded by a memory address word, which is decoded by the address decoder and control circuitry, which controls the memory control and memory address multiplexer functions to cause the input data word to be inserted into the correct memory bank and address directly from the ASCII bus transceivers. There are two memory banks, one for input (ATE → ADT), and one for output (ADT → ATE). These banks are exercised by LISTEN and TALK commands, respectively.

In order to request data from the ADT-222B, the ATE normally sends a LISTEN command followed by a memory address corresponding to the desired data word. The address is decoded the same way input word addresses are decoded. The contents of the addressed memory location are transferred to the ASCII bus transceivers for transmission to the ATE after which the ATE sends a TALK command that is decoded by the address decoder and control function. The address decoder and control then operates the ASCII bus transceivers to transmit the requested data word. If other output data words are required, the ATE sends another LISTEN command, followed by a memory address, followed by a TALK command for each request.

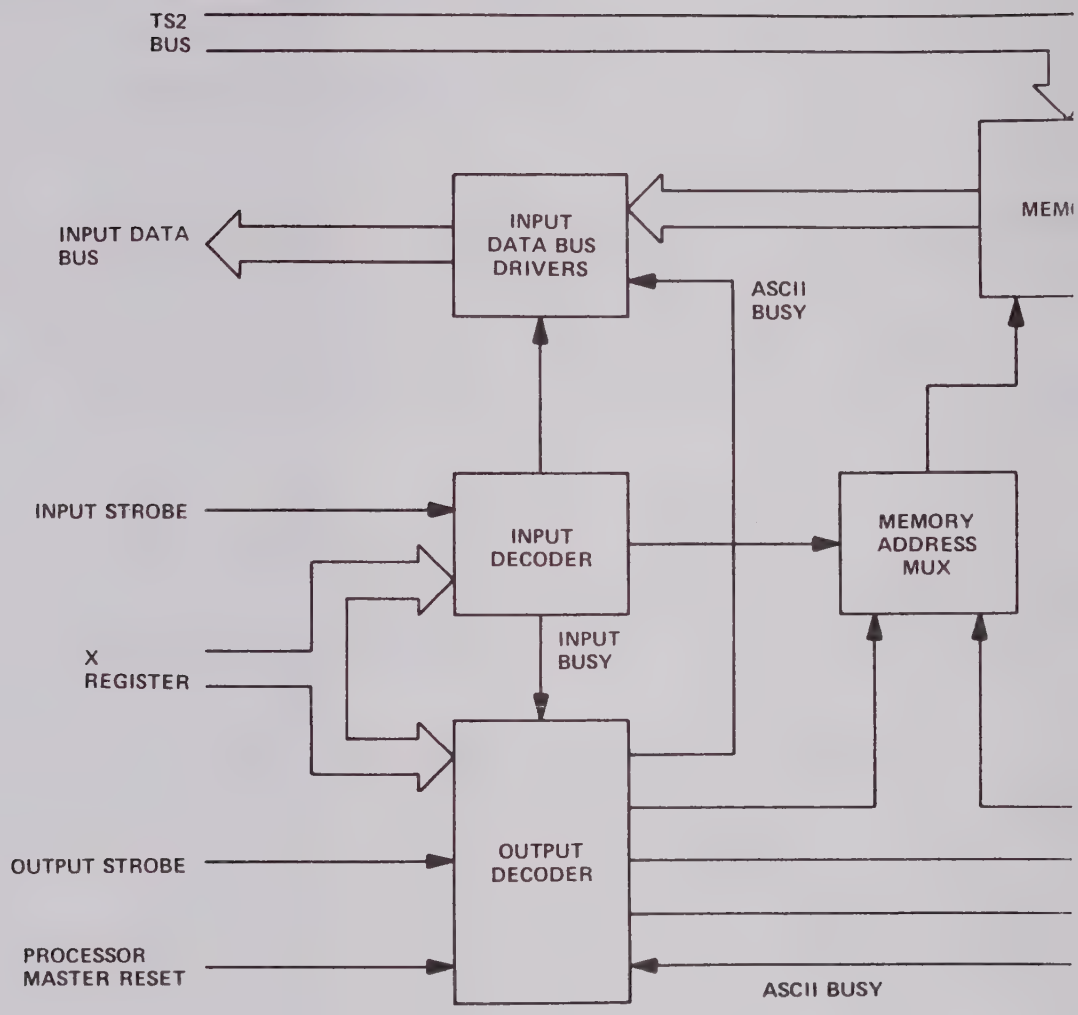
Since the ADT-222B processor and the ATE are both talking to the interface card at their own separate rates, the interface card cannot respond to both at the same time. The input and output decoders and the address decoder and control contain circuitry to lock out conversations with one interface when a conversation is taking place with the other interface. When the ASCII interface is busy, the address decoder and control sends a busy signal to the output decoder, which sends the busy signal to the processor via the input data bus drivers and the input data bus. The processor cannot send data to, or receive data from, the interface card as long as the busy signal is present.

When the processor is in conversation with the interface card, the input decoder sends an input busy signal to the output decoder which relays the signal to the address decoder and control. The address decoder and control then refuses conversations with the ATE until the processor conversation is through.

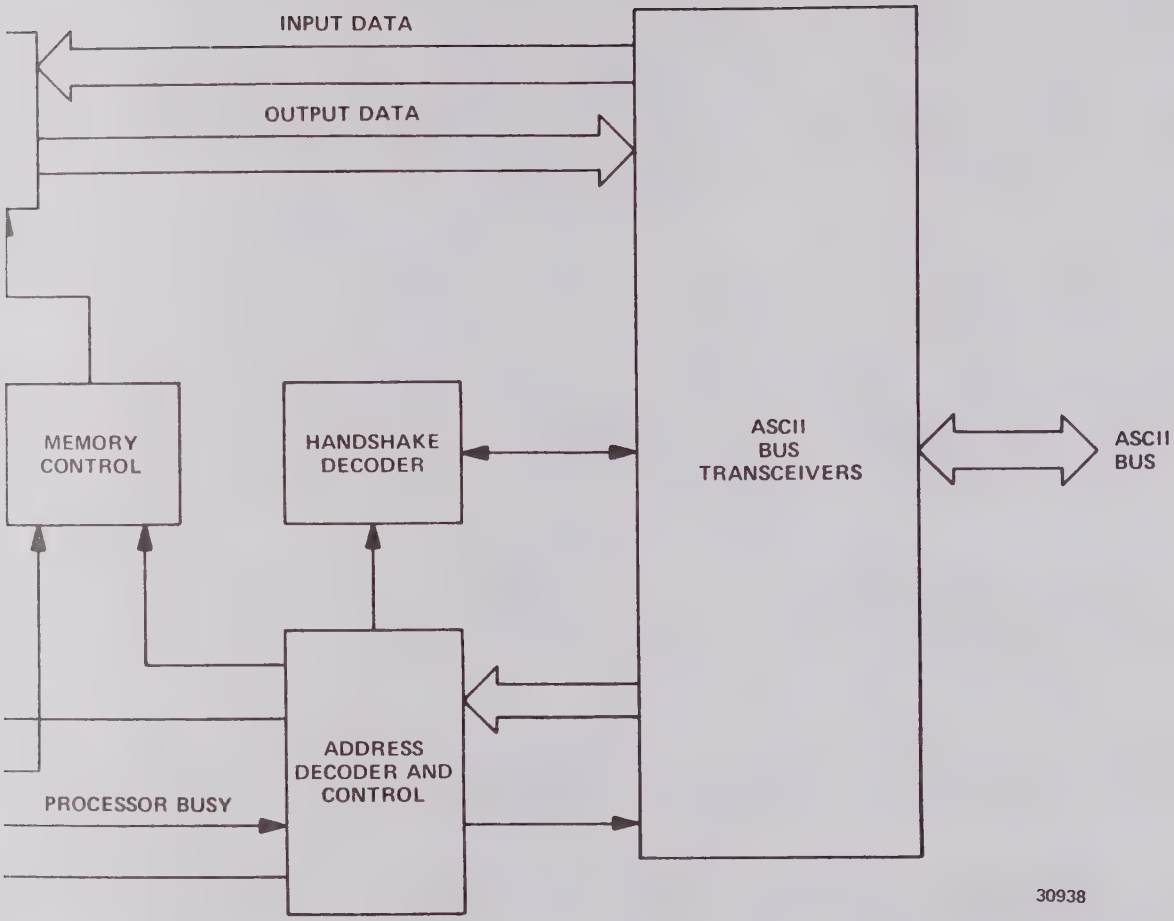
The following is provided for information only and is a description of the internal workings of the ADT-222B bus system. The operator does not need to use the information in the next two paragraphs.

Conversations with the ADT-222B processor are handled in a similar manner. When the processor needs data, an input request is received by the input decoder from the X register. The input decoder then enables the memory address multiplexer and the input data bus drivers to insert the requested input word on the input data bus from the memory.

When the processor is ready to update an interface memory output word, it sends an output instruction to the output decoder via the X register. The output decoder then controls the memory address multiplexer and the memory control to enable the memory to accept the output word from the processor via the TS2 bus.



ASCII Interface Card Block Diagram
Figure 3-1


INPUT DATA
OUTPUT DATA
MEMORY CONTROL
HANDSHAKE DECODER
ASCII BUS TRANSCEIVERS
ASCII BUS
ADDRESS DECODER AND CONTROL
PROCESSOR BUSY
30938

Section 2. Operating Procedures

1. Introduction

Automatic operation of the ADT-222B is controlled entirely by the ATE program. (Refer to section 4 of this chapter for programming instructions.) However, the transitions to and from ATE control may be performed either manually or remotely, using the discrete lines, pins 25 thru 30, on round ATE connector J4. (See figure 3-2 and table 3-1.) It is not necessary to drive these discrete lines when using the rectangular ATE connector, because these functions can be performed via the ASCII bus. (See figure 3-3 and table 3-2.)

2. Procedure

A. To initiate automatic operation manually:

(1) Ensure that the system is operating in the measure mode by pressing one of the display mode pushbuttons.

(2) Press the ATE pushbutton.

B. To terminate automatic operation manually, press the MEASURE pushbutton, and the system reverts to manual operation.

NOTE: The following procedure assumes the system is powered up and operational.

2. C. To initiate automatic operation remotely (via ATE program using the discrete lines):

(1) Initiate L SET M3[1] (M3 is the P_s/P_t display mode); this terminates system self test and establishes P_s/P_t mode.

(2) Initiate L SET ATE[1]; this places system under ATE control.

D. To terminate automatic operation remotely, initiate L SET MSR[1] (front panel measure mode), and the system reverts to MSR mode released from ATE control.

CAUTION: TO AVOID FALSE TEST RESULTS AND POTENTIAL DAMAGE TO THE UNIT, ENSURE THAT THE MANUAL SHUTOFF VALVES REMAIN OPEN WHENEVER A UUT IS CONNECTED TO THE ADT-222B.

---

[1] Any of these three discrete lines may be initiated by pulling the line low to its corresponding return line. The device used to pull the line low must be capable of sinking 10 milliamperes at less than 0.8 volt (such as a mechanical switch or a TTL open collector device). To initiate a line, the line must be pulled low for at least 10 microseconds. A TTL driver with a totem-pole output is not suitable for use here because the lines are wired parallel with front panel switches, and the switches short these lines to ground.

Section 3. Installation/Checkout

1. General Requirements

Installation of the ASCII interface option consists of installing ASCII interface circuit card A10, connecting the interface cable of the ATE system, and verifying ASCII interface option operation.

Operation of the ASCII interface option may be accomplished through utilization of a software program developed to control the ADT-222B. However, in absence of a developed software program, paragraph 4 of this section provides a checkout procedure and sample program that determines whether or not the ADT-222B is operational on the ASCII interface bus.

2. Peripheral Requirements

A. ATE system - With ASCII interface control capabilities

B. Software program - Developed to control ADT-222B over the ASCII interface bus

3. Installation Procedure

CAUTION: POWER MUST BE OFF WHEN INSTALLING OR REMOVING CIRCUIT CARD.

A. Break the seal and remove top cover of ADT-222B to gain access to circuit card mounting.

NOTE: Perform step B. only if software program to control ADT-222B is available.

B. Set address switches on ASCII interface circuit card A10 to agree with your software program. (Refer to section 4 of this chapter and proceed to step D.)

C. Set address switches on ASCII interface circuit card A10 to 0 (down).

D. Install ASCII interface circuit card A10 in its respective place in the ADT-222B. Insert card A10:

(1) Perform visual check of card connector pins to be sure that none are bent or broken.

(2) Visually check mating connector in the card rack for broken pin receptacles.

(3) Insert card A10 in guide rails, ensuring that both card edges are in guide rails.

3. D. (4) Slide card A10 down slowly.

(5) Rock card A10 gently until connector pins engage mating connector.

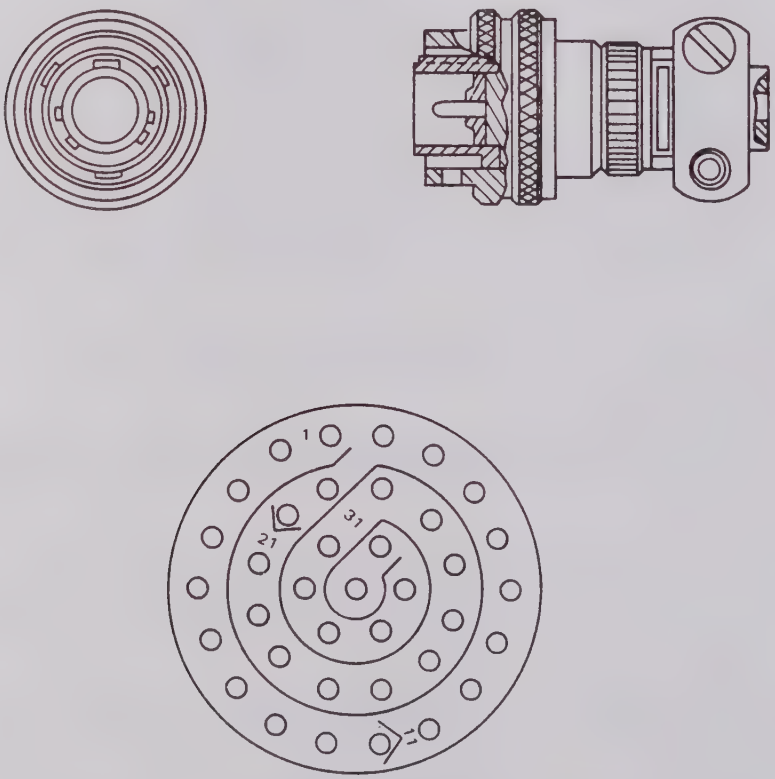
(6) Push firmly in place.

E. Mate connector to ATE connection on the rear panel of the ADT-222B. (See figures 3-2 and 3-3, and tables 3-1 and 3-2.)

F. Install ADT-222B top cover and restore power.

NOTE: If step C. was performed, ignore step G. and proceed to paragraph 4 of this section.

G. If software program to control the ADT-222B is developed and address switches are set in accordance with instructions given in step B., check interface option for proper operation.



ATE Mating Connector (J4 Rear Panel)
Figure 3-2

ASCII Connector Pin	ADT-222B Connector J4 Pin	Signal Name	ASCII Connector Pin	ADT-222B Connector J4 Pin	Signal Name
6	1	DAV	7	17	NRFD
12	2	Shield [1]	9	18	IFC
3	3	DIO3	18	19	Gnd, (6) [1]
2	4	DIO2	21	20	Gnd, (9) [1]
20	5	Gnd, (8) [1]	19	21	Gnd, (7) [1]
15	6	DIO7	22	22	Gnd, (10) [1]
10	7	SRQ	23	23	Gnd, (11) [1]
11	8	ATN	16	24	DIO8
5	9	EOI [2]	NC	25	L SET MSR [3]
1	10	DIO1	NC	26	L SET ATE [3]
13	11	DIO5	NC	27	SET MSR RTN [3]
14	12	DIO6	NC	28	SET ATE RTN [3]
4	13	DIO4	NC	29	L SET M3 [3]
24	14	Gnd, Logic	NC	30	SET M3 RTN [3]
17	15	REN [2]	NC	31 thru 35	SPARE
8	16	NDAC			

[1] Gnd, (n) refers to earth ground return via chassis ground and power cable for referenced ASCII connector pin contact.

[2] EOI and REN return on ASCII connector pin 24.

[3] These discrete signal wires provide the user the capability of putting the ADT-222B into the ATE mode by remote control. If these wires are not connected, the user must manually put the ADT-222B into the ATE mode by operating the front panel ATE pushbutton (whenever the ADT-222B is powered up and in measure mode). These discrete wires are not part of the ASCII bus. (Refer to section 3-2 for operating instructions.)

Rear Panel ATE Connector J4 Wiring
Table 3-1

4. Checkout Procedure

NOTE: If a software program to control the ADT-222B has been developed, perform step A. to verify ADT-222B interface option operation. However, if no software program is available, performance of steps A. thru E. verify proper operation.

A. Verify operation of the unit in accordance with Chapter 2, section 4.

NOTE: Ensure that step B. or C. has been accomplished.

B. After selecting one of the display modes, press ATE button. The button should light and a full six digits (no blanks) should be displayed (if ASCII card A10 has not been updated by the ATE since power was turned on). (See figure 3-4 for the allowable state transitions to ATE operation.)

NOTES: 1. In tables 3-3 and 3-4, the convention assumed for the two interface bus conversations is that a "1" in the table is a low voltage (less than 0.8 volt) on the bus line. (1 = True)

2. Most controllers are capable of ASCII interface and will automatically generate the handshake routine necessary to transfer each word on the interface bus. (See information pertinent to your particular controller to establish the relationship between ASCII characters and ASCII bit patterns.)

C. Perform the program listed in table 3-3 and, at completion, note that:

(1) Pressure readouts are not changing

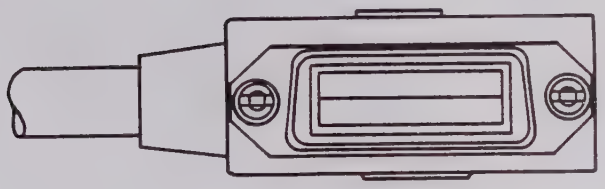
(2) DSSL and DQCL lights are off

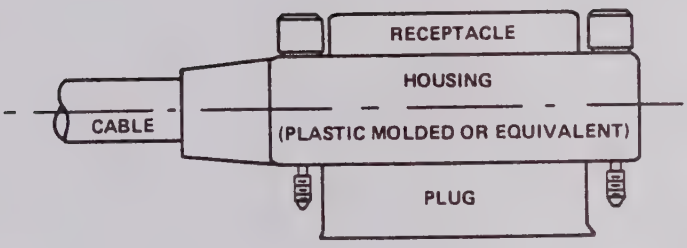
(3) Precision rate lights are not flashing

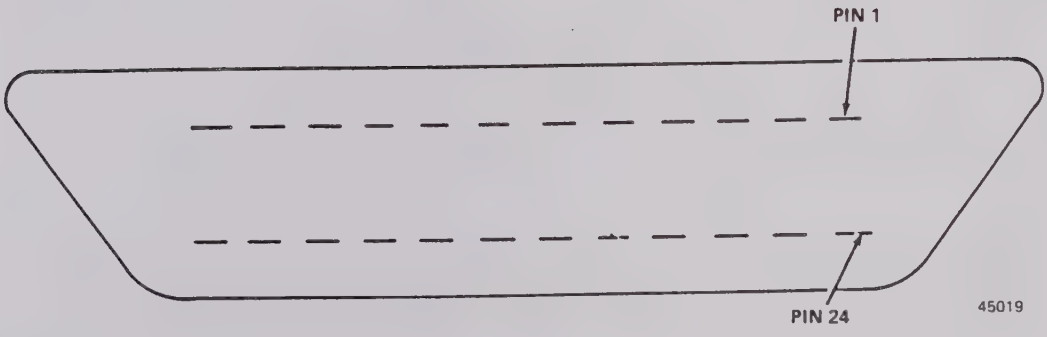
D. After an elapsed time of at least 300 milliseconds from step C., perform the program listed in table 3-4. At completion, note the following:

(1) P_s pressure readout changes to indicate 28.000 inches of Hg at a P_s altitude rate of 30,000 feet per minute.

(2) P_t pressure readout changes to indicate 29.000 inches of Hg at a P_t rate of 400 milli-inch Hg per second.







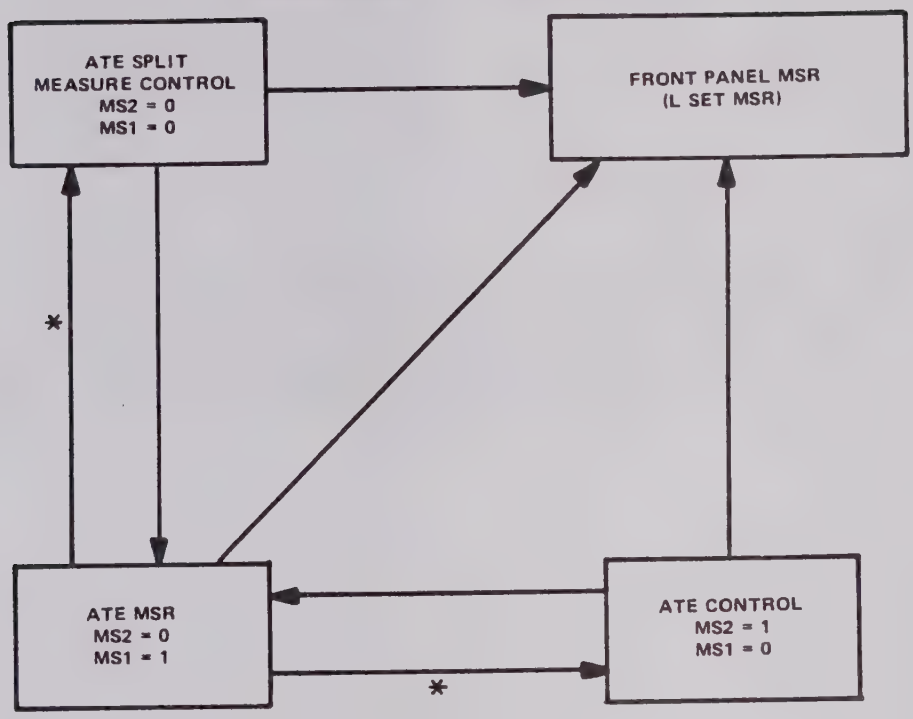
ATE IEEE-488 Mating Connector (J3 Rear Panel)
Figure 3-3

ASCII Connector Pin	ADT-222B Connector J3 Pin	Signal Name	ASCII Connector Pin	ADT-222B Connector J3 Pin	Signal Name
6	1	DAV	4	13	DIO4
12	2	Shield	24	14	Gnd, Logic
3	3	DIO3	17	15	REN [2]
2	4	DIO2	8	16	NDAC
20	5	Gnd, (8) [1]	7	17	NRFD
15	6	DIO7	9	18	IFC
10	7	SRQ	18	19	Gnd, (6) [1]
11	8	ATN	21	20	Gnd, (9) [1]
5	9	EOI [2]	19	21	Gnd, (7) [1]
1	10	DIO1	22	22	Gnd, (10) [1]
13	11	DIO5	23	23	Gnd, (11) [1]
14	12	DIO6	16	24	DIO8

[1] Gnd, (n) refers to earth ground return via chassis ground and power cable for reference ASCII connector pin contact.

[2] EOI and REN return on ASCII connector pin 24.

Rear Panel ATE Connector J3 Wiring
Table 3-2



Functional Transitions
Figure 3-4

NOTE: When all conditions of the checkout procedure have been met, the ADT-222B should be operational on the interface bus. However, before attempting to operate the ADT-222B under ATE control, performance of step E. is essential.

4. E. Remove ASCII interface circuit card A10, and set address switches in accordance with software program developed to control the ADT-222B. (Refer to section 4 of this chapter.)

Conversation No. 1
Table 3-3

ORDER	WORD TRANSMITTED TO ADT-222B								WORD RECEIVED FROM ADT-222B							COMMENT
	ATN	DI07	DI06	DI05	DI04	DI03	DI02	DI01	DI07	DI06	DI05	DI04	DI03	DI02	DI01	
1	1	0	1	0	0	0	0	0								LISTEN ADT-222B (ALL SWITCHES DOWN, SEE FIG.3-5)
2	0	1	0	0	0	0	0	0								ADDRESS $(0100)_8$
3	0	0	1	1	1	0	0	0								RESET CE = 0 (BEFORE ENTERING DATA) [1]
4	0	1	0	0	0	0	0	1								ADDRESS 0101
5	0	0	1	1	0	0	0	0								ENABLE LIMITS, NO DI
6	0	1	0	0	0	0	1	0								ADDRESS 0102
7	0	0	1	1	0	1	1	1								P_s, Pt (IN HG), XPND
8	0	1	0	0	0	0	1	1								ADDRESS 0103
9	0	0	1	1	0	0	1	0								NO PRECISION RATES, ATE FULL CONTROL
10	0	1	0	0	0	1	0	0								ADDRESS 0104
11	0	0	1	1	0	0	0	0								P_s DIGIT 1 = 0
12	0	1	0	0	0	1	0	1								ADDRESS 0105
13	0	0	1	1	0	0	0	0								P_s DIGIT 2 = 0
14	0	1	0	0	0	1	1	0								ADDRESS 0106
15	0	0	1	1	0	0	0	0								P_s DIGIT 3 = 0
16	0	1	0	0	0	1	1	1								ADDRESS 0107
17	0	0	1	1	0	0	0	0								P_s DIGIT 4 = 0
18	0	1	0	0	1	0	0	0								ADDRESS 0110
19	0	0	1	1	1	0	0	0								P_s DIGIT 5 = 8
20	0	1	0	0	1	0	0	1								ADDRESS 0111

Conversation No. 1
Table 3-3 (cont)

ORDER	WORD TRANSMITTED TO ADT-222B								WORD RECEIVED FROM ADT-222B							COMMENT
	ATN	DI07	DI06	DI05	DI04	DI03	DI02	DI01	DI07	DI06	DI05	DI04	DI03	DI02	DI01	
21	0	0	1	1	0	0	1	0								P_S DIGIT 6 = 2
22	0	1	0	0	1	0	1	0								ADDRESS 0112
23	0	0	1	1	0	0	0	0								P_S RATE DIGIT 1 = 0
24	0	1	0	0	1	0	1	1								ADDRESS 0113
25	0	0	1	1	0	0	0	0								P_S RATE DIGIT 2 = 0
26	0	1	0	0	1	1	0	0								ADDRESS 0114
27	0	0	1	1	0	0	0	0								P_S RATE DIGIT 3 = 0
28	0	1	0	0	1	1	0	1								ADDRESS 0115
29	0	0	1	1	0	0	1	1								P_S RATE DIGIT 4 = 3
30	0	1	0	0	1	1	1	0								ADDRESS 0116
31	0	0	1	1	0	0	0	0								P_t DIGIT 1 = 0
32	0	1	0	0	1	1	1	1								ADDRESS 0117
33	0	0	1	1	0	0	0	0								P_t DIGIT 2 = 0
34	0	1	0	1	0	0	0	0								ADDRESS 0120
35	0	0	1	1	0	0	0	0								P_t DIGIT 3 = 0
36	0	1	0	1	0	0	0	1								ADDRESS 0121
37	0	0	1	1	0	0	0	0								P_t DIGIT 4 = 0
38	0	1	0	1	0	0	1	0								ADDRESS 0122
39	0	0	1	1	1	0	0	1								P_t DIGIT 5 = 9
40	0	1	0	1	0	0	1	1								ADDRESS 0123

Conversation No. 1
Table 3-3 (cont)

	WORD TRANSMITTED TO ADT-222B								WORD RECEIVED FROM ADT-222B							
ORDER	ATN	DI07	DI06	DI05	DI04	DI03	DI02	DI01	DI07	DI06	DI05	DI04	DI03	DI02	DI01	COMMENT
41	0	0	1	1	0	0	1	0								P_t DIGIT 6 = 2
42	0	1	0	1	0	1	0	0								ADDRESS 0124
43	0	0	1	1	0	0	0	0								P_t RATE DIGIT 1 = 0
44	0	1	0	1	0	1	0	1								ADDRESS 0125
45	0	0	1	1	0	0	0	0								P_t RATE DIGIT 2 = 0
46	0	1	0	1	0	1	1	0								ADDRESS 126
47	0	0	1	1	0	1	0	0								P_t RATE DIGIT 3 = 4
48	0	1	1	0	0	0	0	0								ADDRESS 0100 [1]
49	0	0	1	1	1	0	0	1								SET CE = 1 [1]
50	1	1	0	1	1	1	1	1								UNTALK (END OF CONVERSATION) [2]

[1] The instruction pair (address and data) that sets the CE (CE = 1) must be sent only after all data have been input to the ADT-222B. If CE = 1 and only partial data has been received by the ADT-222B, the ADT-222B may attempt to operate on these partial instructions when the ATE resets the CE to 0. Setting CE to 1 may be done during the same conversation that data is updated. Do not send incomplete data and set CE = 1.

[2] After UNTALK, at least 0.225 second must elapse before the start of the next conversation to ensure that the ADT-222B internal processor sees the data input from this conversation. The ADT-222B requires a nominal 15 seconds to initialize its pressure control system when commanded to change from the measure mode to the control mode. During this time, the ADT-222B sets NRNC true (1) (not ready for new command).

Conversation No. 2
Table 3-4

ORDER	WORD TRANSMITTED TO ADT-222B								WORD RECEIVED FROM ADT-222B								COMMENT
	ATN	DI07	DI06	DI05	DI04	DI03	DI02	DI01	ATN	DI07	DI06	DI05	DI04	DI03	DI02	DI01	
1	1	0	1	0	0	0	0	0									LISTEN ADT-222B [1]
2	0	1	0	0	0	0	0	0									ADDRESS 0100 [1]
3	1	1	0	0	0	0	0	0									TALK ADT-222B [1]
4									0	0	1	1	1	0	0	0	ACE = 1, READY TO EXECUTE [1]
5	1	0	1	0	0	0	0	0									LISTEN ADT-222B
6	0	1	0	0	0	0	0	0									ADDRESS 0100
7	0	0	1	1	1	0	0	0									CE = 0 [2]
8	1	1	0	1	1	1	1	1									UNTALK, END OF CONVERSATION

[1] Steps 1 thru 4 are optional. These are shown here to demonstrate the technique of reading information from the ADT-222B.

[2] Resetting CE (CE = 0) is the operation that tells the ADT-222B to execute the pressure commands that it has received. The ADT-222B internal processor sees that CE = 0 only after the UNTALK has been sent. Then the pressures start moving.

Section 4. Programming Instructions

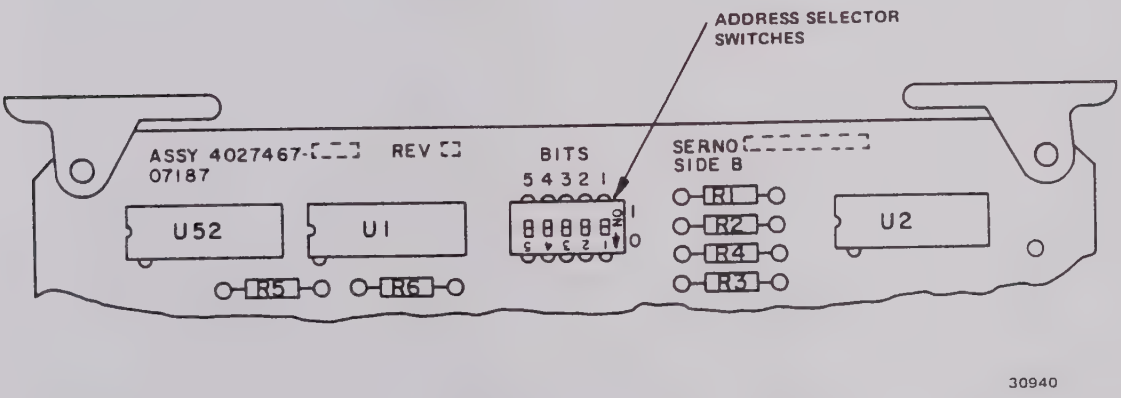
1. General

Programming for automatic operation of the ADT-222B consists of producing software to control the ATE to establish a series of conversations with the ADT-222B. The conversations serve to transmit control data to, and receive test data from, the ADT-222B. This section provides the procedures to be used to establish conversations in accordance with IEEE STD 488-1975, compatible with ADT-222B requirements.

2. Interface Address

The TALK/LISTEN addresses of the ADT-222B are determined by the positions of the five address selector switches located on the top edge of the ASCII interface card A10, as shown in figure 3-5.

The selector switches can be set to match any five-bit address the programmer wishes to use. For example, if you want the ADT-222B to respond to the address 10011, switches 1, 2, and 5 must be set to the off position (1, or up) and switches 3 and 4 must be set to the on position (0, or down). The selected address must be identical to that used in the ATE program, or the ADT-222B does not respond.



Address Selector Switch Location
Figure 3-5

3. Program Instructions and Data Formats

The ADT-222B recognizes six types of words that it can receive from the ASCII bus: four control words and two information words. Each of these words is transmitted over the bus using the three-line handshake routine. The purpose of these words is as follows:

LISTEN - Commands the addressed receiver (ADT-222B) to pay attention and be ready to receive information from the ATE.

UNLISTEN - Tells all bus receivers that they shall disregard further information words passed over the bus until a command addressed to this ADT-222B is received.

TALK - Commands the addressed receiver (ADT-222B) to be ready to transmit data to the ATE. Upon completion of the handshake routine for transmitting this word, the ADT-222B transmits the requested data word as soon as the bus is clear. The word transmitted by the ADT-222B corresponds to the last memory address received by the ADT-222B. If the ATE needs another data word, it must transmit another LISTEN, followed by a memory address, followed by another TALK, and so on.

UNTALK - Tells all bus receivers to stop talk and specifically tells the ADT-222B that the conversation is over. This command relinquishes control of ASCII interface card A10 so that it is available to the ADT-222B processor. To regain control, wait at least 225 milliseconds and send a LISTEN command. The UNLISTEN command should be used if you want the ADT-222B to ignore a word in the bus intended for another receiver. As soon as the ADT-222B receives an UNTALK command, it operates on all instructions stored in card A10, with the possible exception of pressure and pressure rate commands. In order to execute pressure and pressure rate commands, an additional piece of data, the CE (command enter), is needed. The CE must be set to "1" followed by an UNTALK, followed by a 225-millisecond delay. Then CE must be set to "0" followed by an UNTALK. The sequence, without the change in state of the CE, allows mode changes such as changing from P_S in inches of Hg to P_S in feet of altitude without affecting the existing pressures or pressure rates. This is exactly analogous to front panel operations.

Note that data output from the ADT-222B cannot be updated by the ADT-222B internal processor until an UNTALK is sent by the ASCII bus controller. Output data from the ADT-222B is frozen by sending LISTEN and remains frozen until an UNTALK (or interface clear) is sent.

MEMORY ADDRESS - Tells the ADT-222B what data word it is about to receive or transmit. This word should always precede an exchange of data.

DATA - Contains the information transmitted by the ATE. This word is also used to transmit information to the ATE. It is the only word type that is transmitted by the ADT-222B.

Each conversation between the ADT-222B and the ATE starts with a LISTEN and ends with an UNTALK. The ASCII bus formats to be used for these words are given in table 3-5.

Tables 3-6 and 3-7 show the data word memory locations to be used when inputting or outputting data from the ADT-222B. Table 3-6 contains the data input addresses (ATE→ADT) and table 3-7 contains the data output addresses (ADT→ATE). Table 3-8 shows input command dictionary and table 3-9 shows output data and status dictionary. Table 3-10 explains the channel status flags used in tables 3-7 and 3-9. Table 3-11 shows the programmable protection limits defined by the use of the DSSL and DQCL flags used in tables 3-6, 3-7, and 3-8. Table 3-12 shows the BCD DIGIT to DISPLAY.

WORD TYPE	ASCII DATA BITS							
		DIO						
	ATN	7	6	5	4	3	2	1
LISTEN	1	0	1	A	A	A	A	A
UNLISTEN	1	0	1	1	1	1	1	1
TALK	1	1	0	A	A	A	A	A
UNTALK	1	1	0	1	1	1	1	1
MEMORY ADDRESS	0	1	0	M	M	M	M	M
DATA	0	0	1	1	D	D	D	D

KEY: ATN = Logic state of attention line
A = Address bit of ADT-222B (Dependent upon A10 switch settings)
M = Memory address bit (Refer to tables 3-6 and 3-7.)
D = Data bit (Refer to table 3-10.)

ASCII Bus Word Formats
Table 3-5

INPUT MEMORY ADDRESS (BINARY)								INPUT MEMORY ADDRESS (OCTAL)	DATA WORD CONTENTS							
													ASCII DATA BITS			
ATN	7	6	5	4	3	2	1		ATN	7	6	5	4	3	2	1
0	1	0	0	0	0	0	0	0100	0	0	1	1	1	0	0	CE[1]
0	1	0	0	0	0	0	1	0101	0	0	1	1	DSSL	DQCL	DI	O[1]
0	1	0	0	0	0	1	0	0102	0	0	1	1	FS3	FS2	FS1	XPND
0	1	0	0	0	0	1	1	0103	0	0	1	1	PSR	PTR	MS2	MS1
0	1	0	0	0	1	0	0	0104	0	0	1	1	____	P_s DIGIT 1 (LSD) ____		
0	1	0	0	0	1	0	1	0105	0	0	1	1	____	P_s DIGIT 2 ____		
0	1	0	0	0	1	1	0	0106	0	0	1	1	____	P_s DIGIT 3 ____		
0	1	0	0	0	1	1	1	0107	0	0	1	1	____	P_s DIGIT 4 ____		
0	1	0	0	1	0	0	0	0110	0	0	1	1	____	P_s DIGIT 5 ____		
0	1	0	0	1	0	0	1	0111	0	0	1	1	____	P_s DIGIT 6 (MSD)[2]____		
0	1	0	0	1	0	1	0	0112	0	0	1	1	____	P_s RATE DIGIT (LSD)[3]____		
0	1	0	0	1	0	1	1	0113	0	0	1	1	____	P_s RATE DIGIT 2[3]____		
0	1	0	0	1	1	0	0	0114	0	0	1	1	____	P_s RATE DIGIT 3[3]____		
0	1	0	0	1	1	0	1	0115	0	0	1	1	____	P_s RATE DIGIT 4 (MSD)[3]____		
0	1	0	0	1	1	1	0	0116	0	0	1	1	____	P_t DIGIT 1 (LSD) ____		
0	1	0	0	1	1	1	1	0117	0	0	1	1	____	P_t DIGIT 2 ____		
0	1	0	1	0	0	0	0	0120	0	0	1	1	____	P_t DIGIT 3 ____		
0	1	0	1	0	0	0	1	0121	0	0	1	1	____	P_t DIGIT 4 ____		
0	1	0	1	0	0	1	0	0122	0	0	1	1	____	P_t DIGIT 5 ____		
0	1	0	1	0	0	1	1	0123	0	0	1	1	____	P_t DIGIT 6 (MSD)[2]____		
0	1	0	1	0	1	0	0	0124	0	0	1	1	____	P_t RATE DIGIT 1 (LSD) ____		
0	1	0	1	0	1	0	1	0125	0	0	1	1	____	P_t RATE DIGIT 2 ____		
0	1	0	1	0	1	1	0	0126	0	0	1	1	____	P_t RATE DIGIT 3 (MSD)		
0	1	0	1	0	1	1	1	0127	0	0	1	1	ATE[4]	MSR[4]	ME[4]	TP[4]
0	1	0	1	1	0	0	0	0130	0	0	1	1	____	SPARE ____		
0	1	0	1	1	0	0	1	0131	0	0	1	1	____	SPARE ____		

Data Input Formats (ATE→ADT)
Table 3-6

INPUT MEMORY ADDRESS (BINARY)								INPUT MEMORY ADDRESS	DATA WORD CONTENTS						
													ASCII DATA BITS		
ATN	7	6	5	4	3	2	1	(OCTAL)	ATN	7	6	5	4 3 2 1		
0	1	0	1	1	0	1	0	0132	0	0	1	1	____SPARE ____		
0	1	0	1	1	0	1	1	0133	0	0	1	1	____SPARE ____		
0	1	0	1	1	1	0	0	0134	0	0	1	1	____SPARE ____		
0	1	0	1	1	1	0	1	0135	0	0	1	1	____SPARE ____		
0	1	0	1	1	1	1	0	0136	0	0	1	1	____SPARE ____		
0	1	0	1	1	1	1	1	0137	0	0	1	1	____SPARE ____		

[1] The '1' and '0' pattern indicated for addresses $(0100)_8$ and $(0101)_8$ must be received by the ADT-222B exactly as indicated, or the ADT-222B assumes that all input data is invalid, and refuses to execute any command.

[2] $(0100)_2$ = Minus

[3] Processor interprets the P_S rate word as 10 times the value which has been input. That is, P_S rate word of 1000 is read as 10000 feet per minute.

[4] Requires a 0-to-1 transition. (Send "0", untalk, delay, send "1", untalk)

Data Input Formats (ATE→ADT)
Table 3-6 (cont)

OUTPUT MEMORY ADDRESS (BINARY) ASCII DATA BITS								MEMORY ADDRESS (OCTAL)	DATA WORD CONTENTS ASCII DATA BITS			
ATN	7	6	5	4	3	2	1		DI04	DI03	DI02	DI01
0	1	0	0	0	0	0	0	0100	ACE	$\overline{\text{ATE}}$ [1]	NRNC	SFT
0	1	0	0	0	0	0	1	0101	PSR	PTR	PSRA	PTRA
0	1	0	0	0	0	1	0	0102	STPS3	STPS2	STPS1	PSDI
0	1	0	0	0	0	1	1	0103	STPT3	STPT2	STPT1	PTDI
0	1	0	0	0	1	0	0	0104	XSSL	XQCL	CMIV	EQLZ
0	1	0	0	0	1	0	1	0105	PTSAT	PSSAT	PTCFL	PSCFL
0	1	0	0	0	1	1	0	0106	PTCLD	PSCLD	STH	
0	1	0	0	0	1	1	1	0107	FS3	FS2	FS1	XPND
0	1	0	0	1	0	0	0	0110	ATE [1]	MS2	MS1	DI
0	1	0	0	1	0	0	1	0111	DSSL	DQCL	VSSL	VQCL
0	1	0	0	1	0	1	0	0112	REAL TIME CTR		WORD 1 (LSD) [2]	
0	1	0	0	1	0	1	1	0113	REAL TIME CTR		WORD 2 [2]	
0	1	0	0	1	1	0	0	0114	REAL TIME CTR		WORD 3 [2]	
0	1	0	0	1	1	0	1	0115	REAL TIME CTR		WORD 4 (MSD) [2]	
0	1	0	0	1	1	1	0	0116	____P_t	DIGIT 1 (LSD)		
0	1	0	0	1	1	1	1	0117	____P_t	DIGIT 2		
0	1	0	1	0	0	0	0	0120	____P_t	DIGIT 3		
0	1	0	1	0	0	0	1	0121	____P_t	DIGIT 4		
0	1	0	1	0	0	1	0	0122	____P_t	DIGIT 5		
0	1	0	1	0	0	1	1	0123	____P_t	DIGIT 6 (MSD)__[3]		
0	1	0	1	0	1	0	0	0124	X [4]	X	X	X [4]
0	1	0	1	0	1	0	1	0125	____P_s	DIGIT 1 (LSD)		
0	1	0	1	0	1	1	0	0126	____P_s	DIGIT 2		
0	1	0	1	0	1	1	1	0127	____P_s	DIGIT 3		
0	1	0	1	1	0	0	0	0130	____P_s	DIGIT 4		
0	1	0	1	1	0	0	1	0131	____P_s	DIGIT 5		

Data Output Formats (ADT → ATE)
Table 3-7

OUTPUT MEMORY ADDRESS (BINARY) ASCII DATA BITS ATN	7	6	5	4	3	2	1	MEMORY ADDRESS (OCTAL)	DATA WORD CONTENTS DIO4	DIO3	DIO2	DIO1
0	1	0	1	1	0	1	0	0132	$\overline{P_s}$	DIGIT 6 (MSD) [3]		
0	1	0	1	1	0	1	1	0133	X	X	X	X
0	1	0	1	1	1	0	0	0134	BADCM	X	HDOT1	HDOT2
0	1	0	1	1	1	0	1	0135	PTCTA	PSCTA	PTCBP	PSCBP
0	1	0	1	1	1	1	0	0136	PTCAL	PSCAL	CALCM	BADSN
0	1	0	1	1	1	1	1	0137	Z4	Z3	Z2	Z1

[1] $\overline{ATE}$ is the complement of ATE. Verifying that DIO4, 3, and 2 of address $(100)_8$ are '0' guarantees that the ADT-222B pressures are stable and ready to use, or ready for next command. DIO1 X is a DON'T CARE.

[2] The real time counter is a 16-bit binary counter broken up into four 4-bit words. The least significant bit of each word is DIO1. This counter is reset to "0" upon receipt of CE = 1, and starts incrementing upon receipt of CE = 0. The counter increments by 1 count every 0.89478 second. Since this counter state is sent to ASCII card A10 concurrently with P_s and P_t display data (by the ADT-222B internal processor), this allows the ATE to know at what 'time' the pressure measurements were made. Note that the real time counter operates as stated only as long as the contents on input memory address $(102)_8$ (display function) remain unchanged.

[3] $(1101)_2$ = Minus

[4] X signifies that the bit may be either 1 or 0.

Data Output Formats (ADT → ATE)
Table 3-7 (cont)

Mnemonic	Definition
CE	Command Enter
DI	Dynamic Input
DQCL	Disable Q_c Limit
DSSL	Disable Subsonic Limit
FS1, FS2, FS3	Display Function Selection Bits (Refer to Part A.)
LSD	Least Significant Digit
MSD	Most Significant Digit
MS1, MS2	Control Mode Select Bits (Refer to Part B.)
P_S	Static Pressure
PSDI	P_s Dynamic Input
PSR	Precision Rate (P_s Channel)
P_T	Pitot Pressure
PTDI	P_t Dynamic Input
PTR	Precision Rate (P_t Channel)
XPND	Expanded Display Resolution (Refer to Part C.)
EQLZ	Equalization (internal pressure equalization during measure-to-control transition)

PART A

Display Function Selection Bits
(Front Panel Lamps Track ATE Operation.)

FS3	FS2	FS1	Description
0	0	0	Altitude (FT) - Airspeed (KTS)
0	0	1	P_s (IN HG) - Q_c (IN HG)
0	1	1	P_s (IN HG) - P_t (IN HG)
0	1	0	Altitude (FT) - Mach *
1	0	0	Altitude (M) - Airspeed (KM/H)
1	0	1	P_s (MB) - Q_c (MB)
1	1	1	P_s (MB) - P_t (MB)
1	1	0	Altitude (M) - Mach *

* Commands may not be entered in these display modes.

PART B

Control Mode Select Bits
(Front Panel does Reflect ATE Mode.)

MS2	MS1	Description
0	0	P_s Measure - P_t Control
0	1	Measure, Both Channels
1	0	P_s Control - P_t Control

PART C

Expanded Display Resolution

Mode	Decimal Point Location (See Note 1.)	
XPND=0		
Altitude (FT) - Airspeed (KTS)	XXXXXX.	XXXXX.X
Altitude (M) - Airspeed (KM/H)	XXXXXX.	XXXXX.X
P_s (IN HG) - Q_c (IN HG)	XXX.XXX	XXX.XXX
P_s MB) - Q_c (MB)	XXXXX.X	XXXXX.X
P_s (IN HG) - P_t (IN HG)	XXX.XXX	XXX.XXX
P_s (MB) - P_t (MB)	XXXXX.X	XXXXX.X
Altitude (FT) - Mach	XXXXXX.	XXX.XXX
Altitude (M) - Mach	XXXXXX.	XXX.XXX
XPND=1 (See Note 2.)		
Altitude (FT) - Airspeed (KTS)	XXXXXX.	XXXXX.X
Altitude (M) - Airspeed (KM/H)	XXXXXX.	XXXXX.X
P_s (IN HG) - Q_c (IN HG)	XX.XXXX	XX.XXXX
P_s (MB) - Q_c (MB)	XXXX.XX	XXXX.XX
P_s (IN HG) - P_t (IN HG)	XX.XXXX	XX.XXXX
P_s (MB) - P_t (MB)	XXXX.XX	XXXX.XX
Altitude (FT) - Mach	XXXXXX.	XXX.XXX
Altitude (M) - Mach	XXXXXX.	XXX.XXX

Input Command Dictionary
Table 3-8 (cont)

NOTES: 1. These are the decimal point locations assumed by the ADT-222B. The ATE may not transmit decimal points over the ASCII bus to the ADT-222B.

2. XPND=1 operation places inherent limits on the commandable pressure range of operation due to having only six command digits. (See example below.)

Example (P_s/P_t in. Hg)	XPND=0	XPND=1
Maximum P_t (or Q_c Command)	399.999*	39.999
Minimum P_t (or Q_c Command)	-99.999*	-9.999

* These are illegal commands, but they do show the limits imposed by having only six command digits (whose MSD values are 0, 1, 2, and 3 for P_t or Q_c).

Input Command Dictionary
Table 3-8 (cont)

Mnemonic	Definition [1]
ACE	Pressure(s) in Transient [2]
ATE	Under ATE Control
EQLZ	In Equalization Mode
PSCLD, PTCLD	Sensor Cold
PSCFL, PTCFL	Sensor Conversion Failed (ADT-222B is unable to measure pressure(s) correctly).
PSRA, PTRA	Precision Rate Achieved
PSSAT, PTSAT	Control System Channel Saturated or Channel in Auto Slew
STH	Sensor Too Hot
STPS1, STPS2, STPS3	P_s Channel Status (See STPX, table 3-10)
STPT1, STPT2, STPT3	P_t Channel Status
XQCL	Commanded Input Exceeds Q_c Limit
XSSL	Commanded Input Exceeds Subsonic Limit
NRNC	Not Ready for New Command [3]
CMIV	Command Invalid (Non BCD digit received) [4]

[1] All flags are normally a logic 0 and are set to '1' when the condition described is met (when the condition is true).

[2] Pressures are stable when ACE = 0, i.e., when the digital integrator has settled out and the display equals the command.

[3] NRNC is the logical OR of the following flags: XSSL, XQCL, CMIV, and EQLZ.

[4] The CMIV flag is set (CMIV = 1) only after the ADT-222B internal processor receives a non-BCD digit [anywhere from input address $(104)_8$ to $(126)_8$] and sees a CE transition from '1' to '0'.

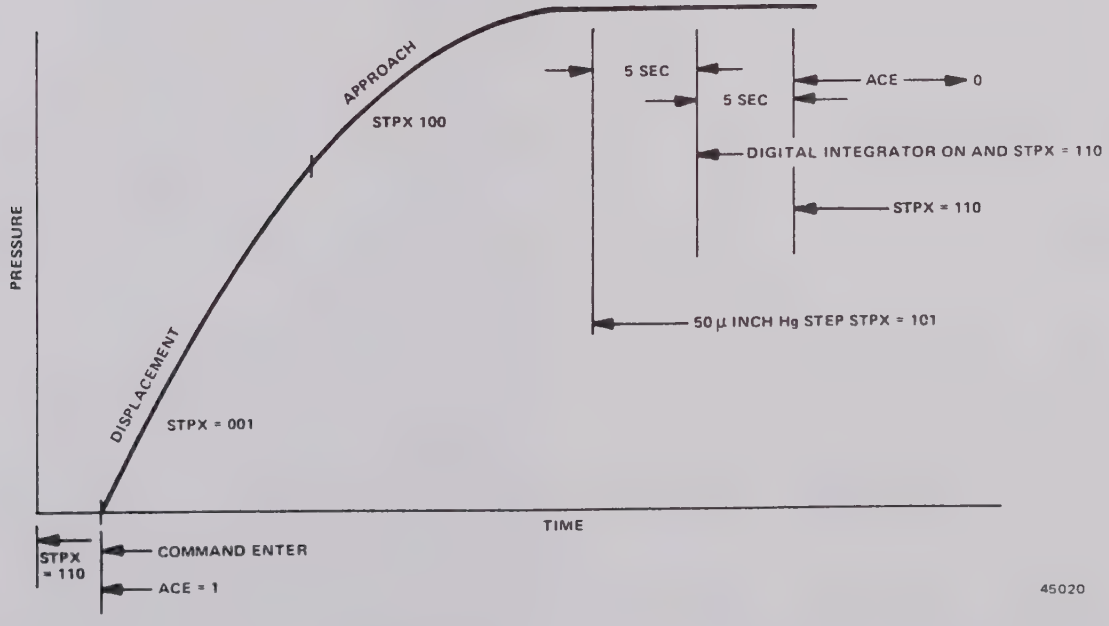
Output Data and Status Dictionary
Table 3-9

State			Definition
STPX3	STPX2	STPX1	State of STPX Control
0	0	1	Displacement State [1]
1	0	1	Pressure Maintenance State [2]
1	1	0	Pressure Maintenance Stable State [3]
1	1	1	Input Command Not Accepted

[1] Pressure is changing.

[2] The P_S or P_t pressure command register is within 50 microinches Hg of the commanded pressure. The digital integrator has not been released. The displayed pressure may not perfectly match the commanded pressure.

[3] Control system is holding pressure stable and digital integrator is operating. Digital integrator is settled out 5 seconds after 110 is seen.



STPX Control Status
Table 3-10

Front DQCL Light	Panel DSSL Light	DQCL	DSSL	P_s Limit	P_t Limit	Q_c Limit	Airspeed Limit (knots)	Altitude Limit (feet)	Altitude Rate Limit (ft/min)	Mach Limit
Off	Off	0	0	$P_s \geq 2.692$ $P_s \leq 32.019$	$P_t \geq 2.692$ $P_t \leq 47.426$	$Q_c \geq -2.016$ $Q_c \leq 15.407$	$Vc \geq .0$ $Vc \leq 525.0$	$H \geq -1888$ $H \leq 55,008$		$M \leq 1$
Off	On	0	1	$P_s \geq .480$ $P_s \leq 32.019$	$P_t \geq 1.480$ $P_t \leq 90.019$	$Q_c \geq -2.016$ $Q_c \leq 74.003$	$Vc \geq 0$ $Vc \leq 1002.6$	$H \geq -1888$ $H \leq 91,337$		$M \leq 3$
On	Off	1	0	$P_s \geq 2.692$ $P_s \leq 32.019$	$P_t \geq 2.692$ $P_t \leq 47.431$	$Q_c \geq -29.327$ $Q_c \leq 44.739$	$Vc \geq 0$ $Vc \leq 813.4$	$H \geq -1888$ $H \leq 55,008$	$\dot{H} \leq 65,000$	None
On	On	1	1	$P_s \geq .312$ $P_s \leq 40.003$	$P_t \geq .480$ $P_t \leq 100.019$	$Q_c \geq -39.523$ $Q_c \leq 99.707$	$Vc \geq 0$ $Vc \leq 1008.4$	$H \geq -2000$ $H \leq 100,683$		None

NOTES:
1. The OFF state for both DQCL and DSSL is automatically selected with power turn on.
2. Commands which violate these limits will cause the ADT-222B to freeze the controller pressures and await a valid command.
3. If the measured pressure exceeds the selected limits in the control modes, the ADT-222B goes to Self-test (SFT) and seals the pressure at the violated boundary. If this occurs, select the next higher DSSL/DQCL limits, go to the control mode, and command the pressure back inside the desired boundaries. When the pressures are back within the desired boundaries, reset the DSSL/DQCL limits.

Programmable Protection Limits
Table 3-11

BCD DIGIT	ASCII BIT 4(MSB)	3	2	1(LSB)	DISPLAY DIGIT
0	0	0	0	0	0
1	0	0	0	1	1
2	0	0	1	0	2
3	0	0	1	1	3
4	0	1	0	0	4
5	0	1	0	1	5
6	0	1	1	0	6
7	0	1	1	1	7
8	1	0	0	0	8
9	1	0	0	1	9
14	1	0	1	0	A
11	1	0	1	1	BLANK
12	1	1	0	0	C
13	1	1	0	1	d [1]
14	1	1	1	0	E
15	1	1	1	1	F
	1	1	0	1	- [1]

[1] $(1101)_2$ is 'd' for all digit positions except MSD. $(1101)_2$ is '-' for MSD.

Interface Bus Digit Coding Format
Table 3-12

4. Conversations

A conversation is an excerpt of a typical program and is a transfer of information between the ATE and the ADT-222B. A sample conversation is presented in table 3-13.

ATN	ASCII WORD (ASCII BITS) 7	6	5	4	3	2	1	SOURCE	WORD TYPE	ACTION
1	0	1	1	1	1	1	1	ATE	UNLISTEN	Clears all active listeners from bus
1	0	1	1	0	0	1	1	ATE	LISTEN	Sets ADT-222B to LISTEN
0	1	0	0	0	1	1	0	ATE	MEMORY ADDRESS	Sets ADT-222B to MEMORY ADDRESS 106 (P_s DIGIT 3)
0	0	1	1	0	1	0	1	ATE	DATA	Put BCD "5" in MEMORY ADDRESS 106
0	1	0	0	1	1	1	1	ATE	MEMORY ADDRESS	Sets ADT-222B to MEMORY ADDRESS 117 (P_t DIGIT 2)
0	0	1	1	1	0	0	1	ATE	DATA	Put BCD "9" in MEMORY ADDRESS 117
0	1	0	1	1	0	0	0	ATE	MEMORY ADDRESS	Sets ADT-222B to MEMORY ADDRESS 130 (P_s DIGIT 4)
1	1	0	1	0	0	1	1	ATE	TALK	Sets ADT-222B to TALK
0	0	1	1	0	1	1	0	ADT-222B	DATA	Output BCD "6" from MEMORY ADDRESS 130
1	0	1	1	1	1	1	1	ATE	UNLISTEN	Clears ASCII bus (NOTE: The UNLISTEN command does not terminate the conversation.)
1	0	1	1	0	0	1	1	ATE	LISTEN	Sets ADT-222B to LISTEN
0	1	0	1	0	0	1	1	ATE	MEMORY ADDRESS	Sets ADT-222B to MEMORY ADDRESS 123 (P_t MSD)
1	0	1	1	0	0	1	1	ATE	TALK	Sets ADT-222B to TALK
0	0	1	1	0	1	0	0	ADT-222B	DATA	Output BCD OF "4" from MEMORY ADDRESS 123
1	1	0	1	1	1	1	1	ATE	UNTALK	Clears all talkers from bus, terminates conversation with ADT-222B.

Sample Conversation
Table 3-13

5. Programming Constraints

Programming constraints are imposed by the ADT-222B to compensate for inherent timing requirements. Adherence to these constraints ensure correct information transfer to and from the ADT-222B.

A. Command Enter

In order to command the ADT-222B to attain a new set of pressures, the command enter CE = 1 must be entered. Data which has been input to the ADT-222B may not be changed while CE = 1. The ADT-222B processor transmits ACE = 1 to the interface card. The ACE flag is not reset to 0 by the processor until the commanded pressures have been obtained and CE = 0. (Note that execution of a command by the ADT-222B does not begin until CE = 0 is received.) Also, when in Altitude-Mach, CE is ignored.

B. Timing Constraints

(1) Interaction of ADT-222B and ATE processors

The I/O of the ADT-222B must allow for synchronous transfer of information between two unsynchronized digital processors (the ADT-222B and ATE processors). To eliminate the possibility of partial information transfers, the ADT-222B I/O talks to only one of the digital processors at any time. Realizing then that full time usage by either processor locks out the other processor, a constraint must be placed on the ATE programmer. At least 225 milliseconds must elapse between CONVERSATIONS between ATE and the ADT-222B I/O. Then all commands written into the ADT-222B I/O during the last CONVERSATION have been read by the ADT-222B digital processor and all I/O output data has been refreshed. A conversation is terminated by sending an UNTALK. Approximately 300 milliseconds delay is recommended to minimize the probability that both processors lock each other out in synchronism. The ADT-222B processor access rate is 224 milliseconds.

(2) Mode change stabilization consideration

The programmer, after commanding the ADT-222B to enter or exit from the measure mode, must wait 20 seconds for the ATE pressures to settle and for the automatic matching routines to be performed. Alternatively, the transition of EQLZN from 1 to 0 may be used to detect the end of pressure equalization by the ADT during the transition from a measure mode to a pressure control mode. Please note that EQLZN=1 may not be transmitted by the ADT-222B for the first 3 seconds of the equalization routine.

(3) Stabilization time consideration

In order to attain the accuracy and stability specified for the ADT-222B, the ATE program must wait until after the ACE flag drops before taking data.

5. B. (4) Precision Rate Usage

Precision rate flags (PSR and PTR) may be changed by the ATE only when the ADT-222B is in ATE CONTROL (not ATE MEASURE) and when ACE = 0. Also, neither precision rate may be requested while DI = 1.

C. Dynamic Input Constraints

The ADT-222B can also be used to generate small amplitude pressure waves by connecting a function generator to the dynamic input connector, located on the back panel. The dynamic input is subjected to the following constraints:

(1) ADT-222B must be operated in control mode only.

(2) Input stimulus can be applied to only one side at a time (P_s or P_t). Side selection is via switch on ADT-222B rear panel.

(3) Bandwidth is limited to between dc and 1.5 Hz minimum with a load of 0 to 20 cubic inches.

(4) DI = 1 may be sent by the ATE only when in ATE CONTROL (not ATE MEASURE) and when ACE = 0 and PSR = PTR = 0.

D. UNTALK/UNLISTEN Constraints

The command UNTALK releases the processor in the ADT-222B to perform its last instructions. It may attempt to do this even if the instructions are incomplete when the command is given. The command UNLISTEN tells the ADT-222B to ignore the data in the bus and puts the ADT-222B in a stand-by mode waiting for the completion of the conversation. It does not perform any functions until the UNTALK command is given. The use of UNTALK in this fashion does not disrupt the ASCII bus operation with other equipment.

E. Figure 3-4 illustrates the only allowed functional transitions which may be commanded by the ATE.

F. Initialization of ASCII Interface Card by ATE

The ADT-222B may be placed in the ATE mode whether the ATE (ASCII bus controller) is in line or not. However, in the first conversation, the ATE must update all appropriate memory input addresses [$(100)_8$ thru $(126)_8$]. Thereafter, the ATE need update only those input data which are to be changed; the ATE may update all input data addresses. The ATE may update input data addresses at any time that the ADT-222B has power applied.

6. ASCII Flags

ASCII FLAGS

ATE → ADT		ADT → ATE	
TP [1]	True Pressure	PSCBP, PTCBP	Calibration Bypass
ATE [1], MSR [1], M3 [1]	Used to implement remote local	PSCTA, PTCTA	Calibration Table
		PSCAL, PTCAL	Calibration
		CALCM	Cal. Entry Complete
		BADSN	Bad Sensor
		BADCM	Bad Command
		SFT	Self Test
		VSSL	Violate SSL
		VQCL	Violate QCL
		HDOT1, HDOT2	H limits
		PSDI, PTDI	Dynamic Input
		Z1, Z2, Z3, Z4	Model No. ID Code

[1] The ADT-222B processor is looking for a 0-to-1 transition on these flags. These flags should remain 0 until a transition is required.

A. ATE to ADT Flags (ATE → ADT)

Calibration can be accomplished via the ASCII bus by setting the true pressure flag (TP) to 0, and after the true pressure is established and the ASCII command digits have been properly set, by setting TP from 0 to 1. The ADT-222B processor is looking for a 0-to-1 transition to activate the calibration point storage. When the ADT-222B processor has finished the storage, the calibration entry complete flag (CALCM) is set true. The number of calibration points remaining appears on the ASCII display for 5 seconds. When the ASCII operator sees CALCM go true, he can set TP to 0 and begin generating the next true pressure. When the TP flag goes to 0, the ADT-222B processor sets the CALCM flag to 0. This completes the cycle and the system is ready for the next calibration point.

This TP/CALCM sequence is always followed, except in the table display mode where the CALCM flag stays low. However, it is possible that a bad sensor or a bad command flag could come true. These flags are set for as long as the BAD S or BAD C symbols are in the display (at least 5 seconds after the receipt of the true pressure 0-to-1 transition). The ATE programmer should always check the states of these flags after the CALCM flag goes true. If either of these flags is true, the calibration point pair was not stored.

Calibration cannot be accomplished in the ATE expanded decimal mode (XPND=1). If this is attempted, a bad command flag will be set. In addition, the table display mode is not presented with the expanded decimal, regardless of the XPND bit state. The table display should be interrupted with the LSD resolution of 1 milli-inch Hg. It is recommended that the ATE programmer read the section on manual calibration before attempting to write ATE software to calibrate via ATE. Note that manual operation of the internal switch bits PSCAL or PTCAL is necessary to put the unit into, and take it out of, the calibration mode. Tables 3-6 and 3-7 show the data word memory locations to be used when inputting or outputting data from the ADT-222B.

6. B. Remote Local Command

The ATE, MSR, and M3 flags are the same and use three discrete wire pairs. The sequence of using these is the same. The remote/local result can be accomplished via the ASCII bus without driving the discretes by using these three new flags. The ADT-222B processor is looking for a 0-to-1 transition on each of these flags. Thus, all three flags should be set to 0 during ATE initialization. The sequence used to take the ADT-222B from front panel control to ATE and in reverse via the ASCII bus is discussed below.

(1) ATE Initialization

Reset MSR, M3, and ATE to 0.
Untalk*

(2) Front Panel to ATE Control

Set MSR and M3 to 1.
Untalk*, Unit goes to front panel P_s/P_t measure mode.
Delay 300 ms.
Reset MSR and M3 to 0 and set ATE to 1.
Untalk*, Unit goes to ATE mode.
Set ATE to 0 on next conversation.

(3) ATE Control to Front Panel

Set MSR and M3 to 1
Untalk*, Unit goes to front panel P_s/P_t measure mode.
Set MSR and M3 to 0 on next conversation.

*After every untalk, there must be a delay of approximately 300 milliseconds before attempting to address the ADT-222B again. Do not allow the delay to be near a multiple of 224 milliseconds.

6. B. (4) ADT to ATE Flags (ADT → ATE)

All of the flags associated with the calibration systems are sent to the ASCII bus. The four remaining flags are discussed below.

(a) Self Test Flag (SFT)

Whenever the ADT-222B enters the self test mode, this flag is set true on the ASCII bus.

(b) Pressure Violation of Flight Envelope (VSSL and VQCL)

Whenever the P_S or P_t pressures (not the pressure commands) exceed the SSL QCL limit table, the VSSL or the VQCL flags are set on the ASCII bus. They remain set as the ADT-222B goes to self test. They are reset when the pressures are back within the SSL QCL limits and the ADT-222B is not in self test. Pressure violation of the DQCL limit causes the VQCL flag to come true; however, violation of the DSSL limit causes both the VSSL and VQCL flags to come true.

(c) New Display Symbols

A Ø Ø Ø Y Y	Y Y = Calibration points remaining
X X X X C E	Calibration error - used outside the calibrated range
B A d. Ø Ø S.	Bad sensor - sensor error exceeds calibration range
X X X C S F	Checksum fail in EAROM
B A d. Ø Ø C. entry	Bad command - invalid true pressure

(d) Dynamic Input Flags (PSDI and PTDI)

The PSDI and PTDI flags provide feedback to the program controlling the ADT-222B. When the program sets the DI flag to initiate dynamic input to the ADT-222B, the ADT-222B then tells the program if it is set for the P_S or P_T channel by setting the appropriate flag, PSDI for P_S channel, and PTDI for P_T channel.

6. B. (4) (e) Model Number Identification Codes

A four-bit ID code has been set up on the ASCII bus to allow the ATE user program to identify the model number of the ADT-222 he is driving (ADT-222X). Refer to the following DATA WORD information in table 3-14 and to table 3-7 (ADT → ATE).

MODEL NUMBER	Z_4	Z_3	Z_2	Z_1
ADT-222	X	X	X	X[1]
ADT-222A	X	X	X	X[1]
ADT-222A (MOD C)	0	0	1	0
ADT-222B	0	0	1	1

[1] These states are controlled by the contents of the A10 RAMS when power is applied to the ADTS. Usually, they are either all "0" or all "1".

DATA WORD Information
Table 3-14

6. C. Data Words Format

All data words transmitted by the ADT-222B over the ASCII bus have the following format.

ATN = 0

DI08 = 0

DI07 = 0

DI06 = 1

DI05 = 1

DI04 = Data Word Contents

DI03 = Data Word Contents

DI02 = Data Word Contents

DI01 = Data Word Contents

D. Flags/Modes

The important flags for each mode are shown below.

(1) Self Test Mode

ATE
SFT
VSSL } For pressure limit violation, the unit returns to self test.
VQCL }

(2) Front Panel and ATE Measure Mode

ATE	STH
SFT	FS3, FS2, FS1
PTCFL	MS2, MS1
PSCFL	DSSL, DQCL
PTCLD	VSSL, VQCL
PSCLD	Z4, Z3, Z2, Z1

6. D. (3) Front Panel and ATE Control Mode

ACE	XSSL	XPND [1]
ATE	XQCL	MS2, MS1
SFT	CMIV [1]	DI [1]
PSR	EQLZ	PSDI [1]
PTR	PSSAT, PTSAT	PTDI [1]
PSRA	PSCFL, PTCFL	DSSL, DQCL
PTRA	PSCLD, PTCLD	VSSL, VQCL
STPS3, 2, 1	STH	HDOT 1, HDOT 2
STPT3, 2, 1	FS3, FS2, FS1	NRNC [1]

[1] ATE Control Mode only

(4) Calibration Mode

BADCM, BADSN	PTCAL, PSCAL
PTCTA, PSCTA	CALCM
PTCBP, PSCBP	Z4, Z3, Z2, Z1

Section 5. Maintenance

1. General

Maintenance of ASCII interface card A10 consists of exchanging the card only. However, the following isolation procedures should be performed to verify the required replacement.

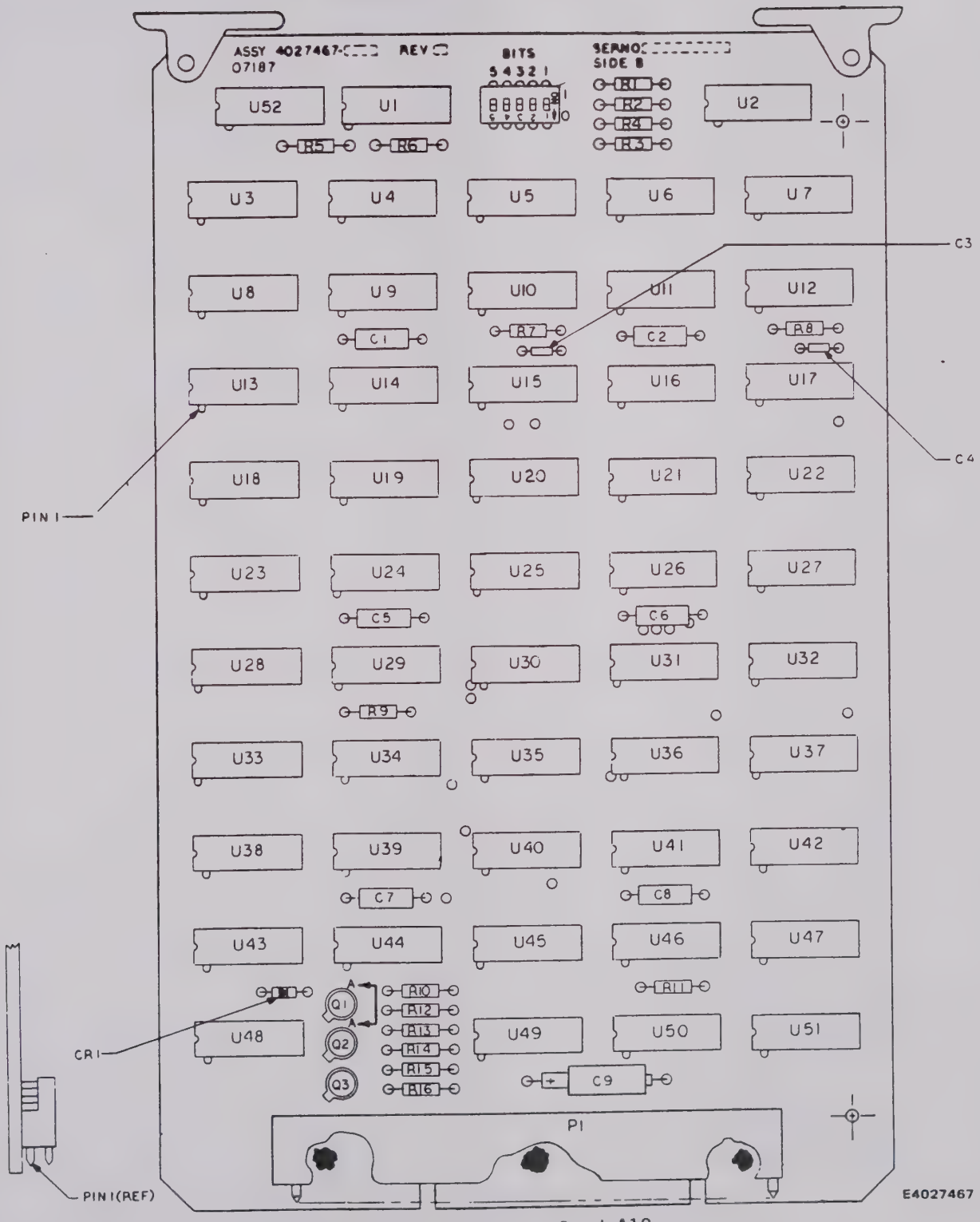
2. Procedure

A. Verify that the address switches are properly set. Refer to section 4 of this chapter for the procedure.

B. Verify that the ADT-222B works but will not function under ATE control. Figure 3-6 is included as an aid for isolating suspected failures.

C. Replace interface card A10. Refer to section 3 of this chapter for the procedure.

Revision Index (Arrow Designation)	Revision Description	Effectivity



ASCII Interface Card A10
Schematic
Figure 3-6 (Sheet 1 of 9)

8 | 7

G

F

E

D

C

ITEM NO	REF DES	SPERRY PART NO	TOL	RATING
2	C1	2501629-61	±10%	100V
2	C2	-61		
3	C3	-41		
4	C4	-13		
2	C5	-61		
2	C6	-61		
2	C7	-61		
2	C8	2500169-61	±10%	100V
5	C9	2503221-23	±20%	15V
8	R1	2500932-49	±5%	1/4W
8	R2	-49		
8	R3	-49		
8	R4	-49		
8	R5	-49		
9	R6	-56		
10	R7	-65		
10	R8	-65		
11	R9	-57		
11	R10	-57		
8	R11	-49		
11	R12	-57		
12	R13	-39		
8	R14	-49		
12	R15	-39		
8	R16	2500932-49	±5%	1/4W
6	Q1	2504649-2		
7	Q2	4002240-202		
7	Q3	4002240-202		
13	CR1	2503517-3		
14	S1-S5	4021678-5		
			VCC	GND
15	U1	4017938-485	16	8
16	U2	4002668-486	14	7
17	U3	4003165-400		
18	U4	4023702-427		
19	U5	4003165-404		
20	U6	4003165-402		
20	U7	4003165-402		
18	U8	4023702-427		
18	U9	4023702-427		
21	U10	4003165-410		
22	U11	4003485-474		
17	U12	4003165-400		
21	U13	4003165-410		
20	U14	4003165-402		
23	U15	4006195-421		
22	U16	4003485-474		
23	U17	4006195-421		
17	U18	4003165-400		
21	U19	4003165-410	14	7
24	U20	4002669-475	5	12
20	U21	4003165-402	14	7
17	U22	4003165-400	14	7
19	U23	4003165-404	14	7
24	U24	4002669-475	5	12
24	U25	4002669-475	5	12
25	U26	2501402-409	5	10
19	U27	4003165-404	14	7
26	U28	4021563-460	16	8
27	U29	4017936-457	16	8
29	U30	4014785-10		
27	U31	4017936-457	16	8
26	U32	4021563-460	16	8
26	U33	4021563-460	16	8
30	U34	4003486-407	14	7
20	U35	4003165-402	14	7
18	U36	4023702-427	14	7
26	U37	4021563-460	16	8
19	U38	4003165-404	14	7
	U39	-		
	U40	-		
19	U41	4003165-404		
17	U42	4003165-400		
19	U43	4003165-404		
31	U44	4016987-438	14	7
32	U45	4014787-14		

ASCII Interface Card A10
Schematic
Figure 3-6 (Sheet 2)

ITEM NO	REF DES	SPERRY PART NO.	VCC	GND
31	U46	4016987-438	14	7
20	U47	4003165-402	14	7
18	U48	4023702-427	14	7
33	U49	4014787-18		
22	U50	4003485-474	14	7
34	U51	4003165-405	14	7
21	U52	4003165-410	14	7

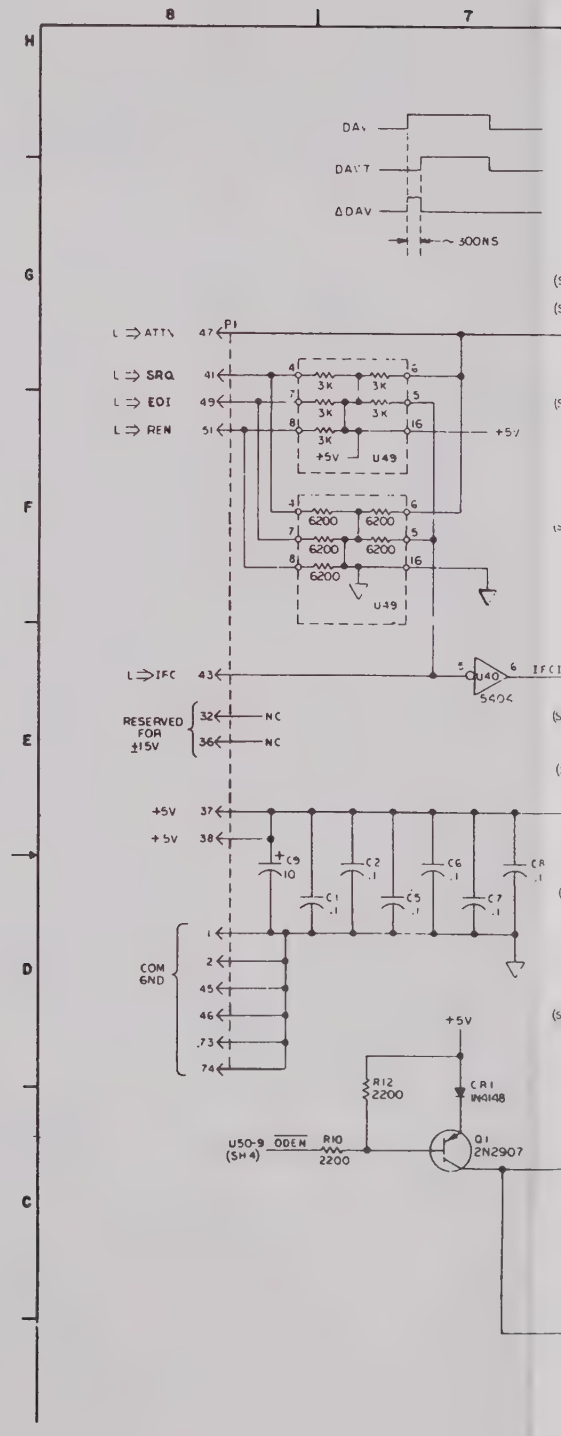
MNEMONICS

ATTN — ATTENTION
SRQ — SERVICE REQUEST
DAV — DATA VALID
NRFD — NOT READY FOR DATA
REN — REMOTE ENABLE
NDAC — NOT DATA ACCEPTED
DI_ — DATA BIT
IFC — INTERFACE CLEAR
DAVT — DATA VALID DELAYED
ΔDAV — DATA VALID DIFFERENCE STROBE
WTIF — WAIT TIL I'M FREE
STLKD↑ — SET TALKED F/F ON ↑ EDGE
CLRTLKD — CLEAR TALKED F/F
RFD — READY FOR DATA
DAC — DATA ACCEPTED
TLKD — TALKED F/F
ODEN — OUTPUT DATA ENABLE (TO ASCII BUS)
LSTND — LISTENED F/F
UNLSTN — UNLISTEN
CA — CORRECT ADDRESS (LOWER BITS)
LA — LISTEN ADDRESS
TA — TALK ADDRESS
PROC — PROCESSOR CONTROL F/F
ATE ADR — ATE MEMORY ADDRESS (STROBE)
DATA — DATA STROBE
ATEC — ATE CONTROL F/F
MR — MASTER RESET
WRONG TLK — WRONG TALK ADDRESS
PIA_ — PROCESSOR INPUT MEMORY ADDRESS BIT
CIR — CORRECT INPUT REQUEST BLOCK
SDU — START DATA UPDATE
RDD — READ DISPLAYED DATA
COB — CORRECT OUTPUT BLOCK
DTP — DATA TRANSFER PULSE
IDE — INPUT DATA ENABLE (TO PROCESSOR)
IN ID — INPUT ID STROBE
UNC — UNCONTROL
XB_ — X REGISTER BIT
POA_ — PROCESSOR OUTPUT MEMORY ADDRESS BIT
ABA_ — ATE BIDIRECTIONAL MEMORY ADDRESS BIT
PD_ — PROCESSOR DATA BIT
TS2 — TS2 REGISTER (BUS)
AD_ — ATE DATA BIT

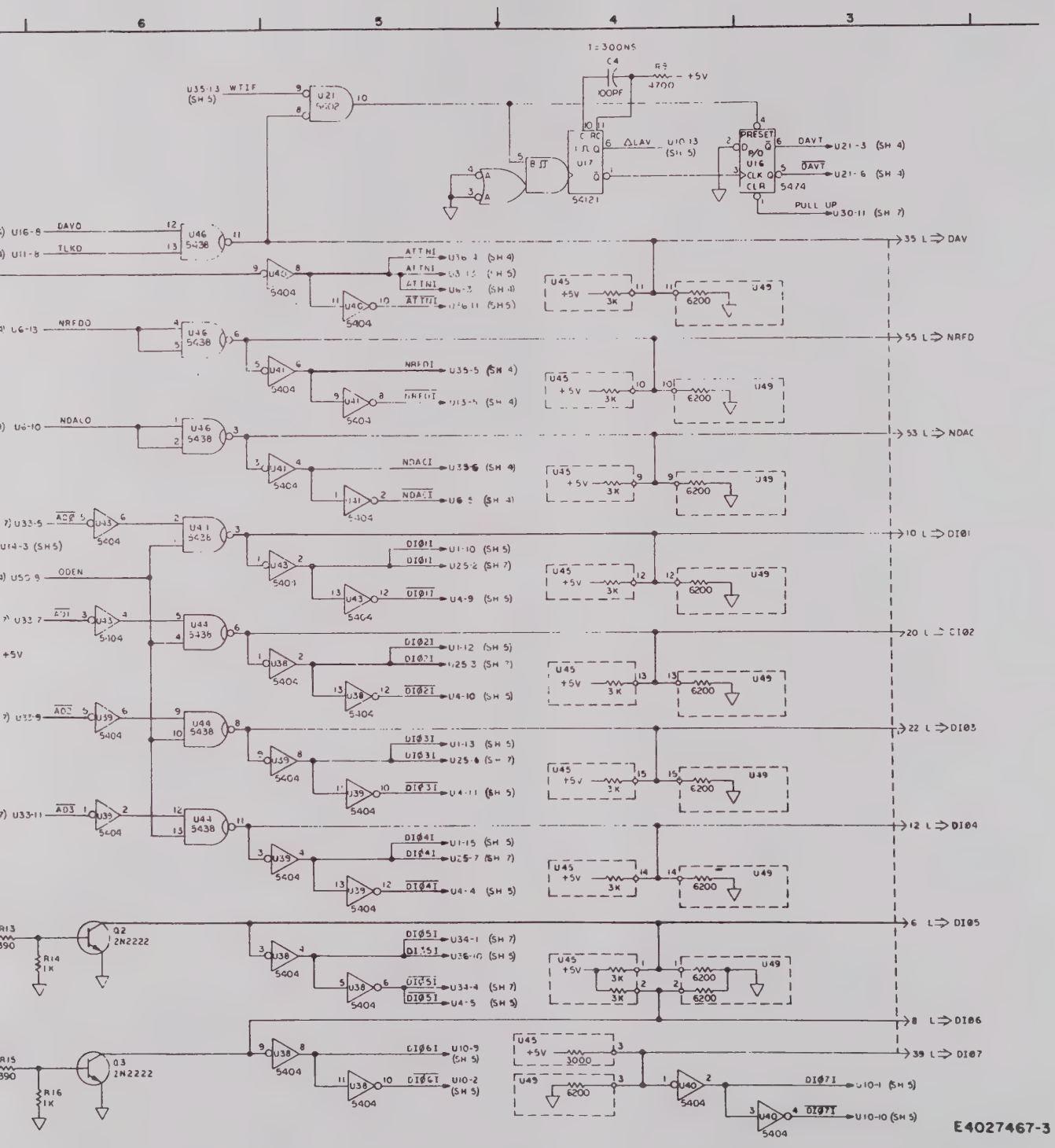
NOTES:

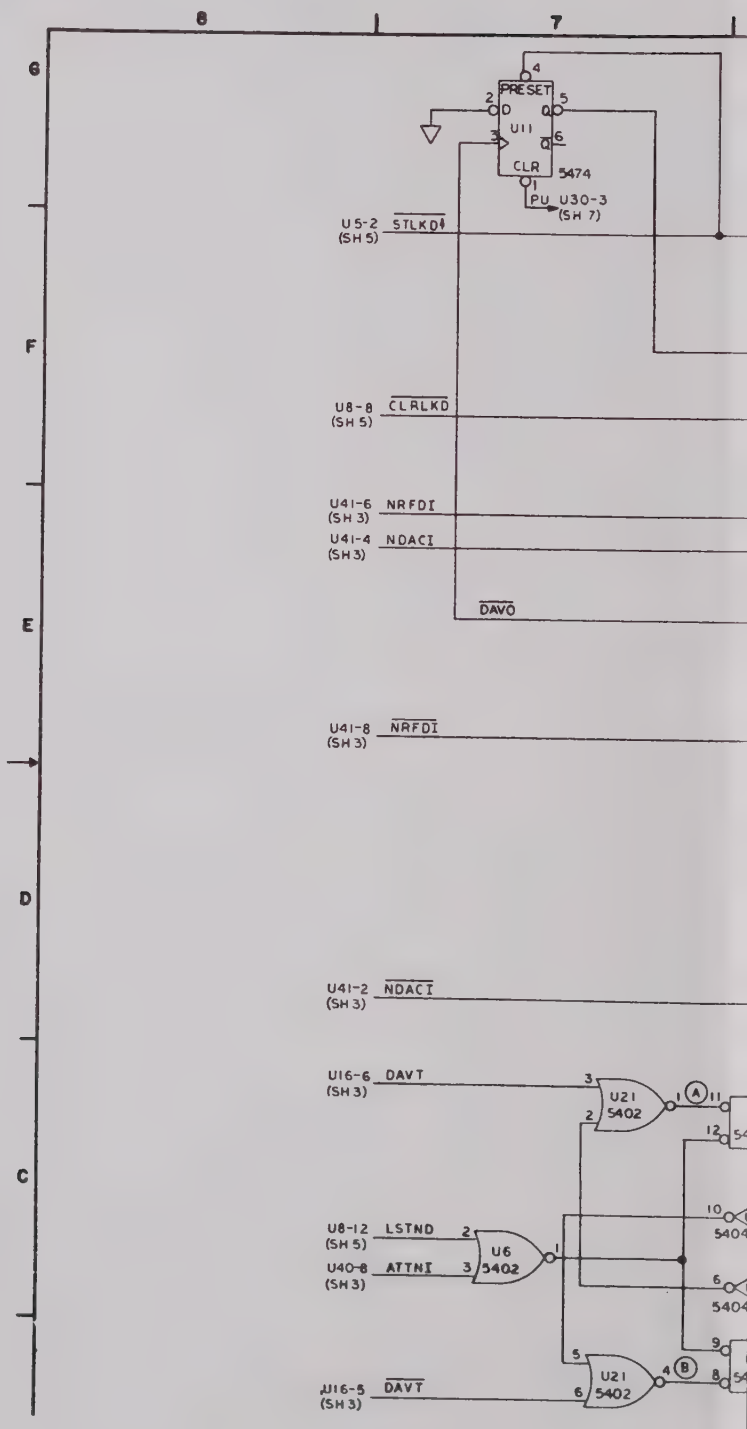
UNLESS OTHERWISE SPECIFIED:

1. **ALL CAPACITANCE VALUES ARE IN MICROFARADS.**
2. **ALL RESISTANCE VALUES ARE IN OHMS.**
3. **PARTIAL REFERENCE DESIGNATIONS ARE SHOWN; FOR COMPLETE DESIGNATIONS PREFIX PART DESIGNATION WITH SUBASSEMBLY DESIGNATION.**

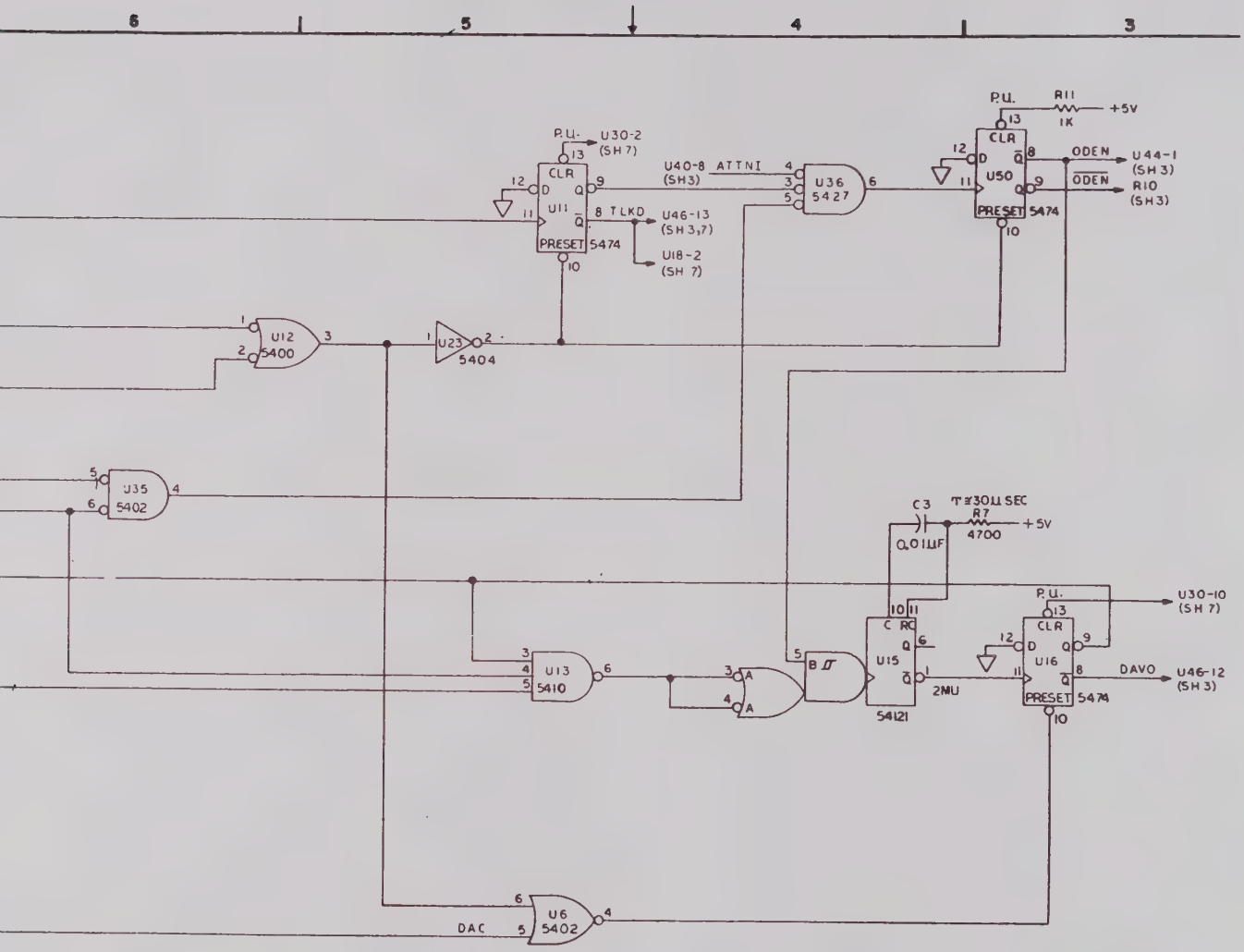


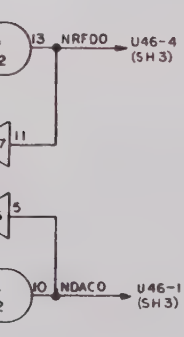
ASCII Interface Card A10
Schematic
Figure 3-6 (Sheet 3)

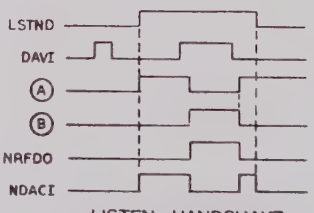

T=300NS
C4
100PF
R5
4700
+5V
U35-13 WTIF (SH 5)
U21
5402
PRESET
U16
CLR
5474
DAVT
U21-3 (SH 4)
U21-6 (SH 4)
PULL UP
U30-11 (SH 7)
U17
54121
ΔLAV
U10-13 (SH 5)
U16-8 DAVO
U11-8 TLKO
U46
5438
U40
5404
ATTNI
U36-3 (SH 4)
U3-13 (SH 5)
U6-3 (SH 4)
U6-11 (SH 5)
U45
+5V
3K
6200
U49
35 L DAV
U6-13 NRFDO
NRFDI
U35-5 (SH 4)
55 L NRFD
U6-10 NDACO
NDACI
U6-5 (SH 4)
53 L NDAC
U33-5 ACØ
U14-3 (SH 5)
U41
5404
DIØ1I
U1-10 (SH 5)
U25-2 (SH 7)
U4-9 (SH 5)
10 L DIØ1
U50-9 ODEN
U33-7 AD1
U44
5438
+5V
U38
5404
DIØ2I
U1-12 (SH 5)
U25-3 (SH 7)
U4-10 (SH 5)
20 L DIØ2
U33-9 AD2
U39
5404
DIØ3I
U1-13 (SH 5)
U25-8 (SH 7)
U4-11 (SH 5)
22 L DIØ3
U33-11 AD3
DIØ4I
U1-15 (SH 5)
U25-7 (SH 7)
U4-4 (SH 5)
12 L DIØ4
R13
390
R14
1K
Q2
2N2222
DIØ5I
U34-1 (SH 7)
U36-10 (SH 5)
U34-4 (SH 7)
U4-5 (SH 5)
6 L DIØ5
8 L DIØ6
R15
390
R16
1K
Q3
2N2222
DIØ6I
U10-9 (SH 5)
U10-2 (SH 5)
3000
39 L DIØ7
DIØ7I
U10-4 (SH 5)
U10-10 (SH 5)
E4027467-3



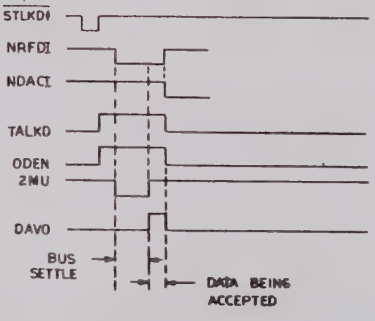
ASCII Interface Card A10
Schematic
Figure 3-6 (Sheet 4)





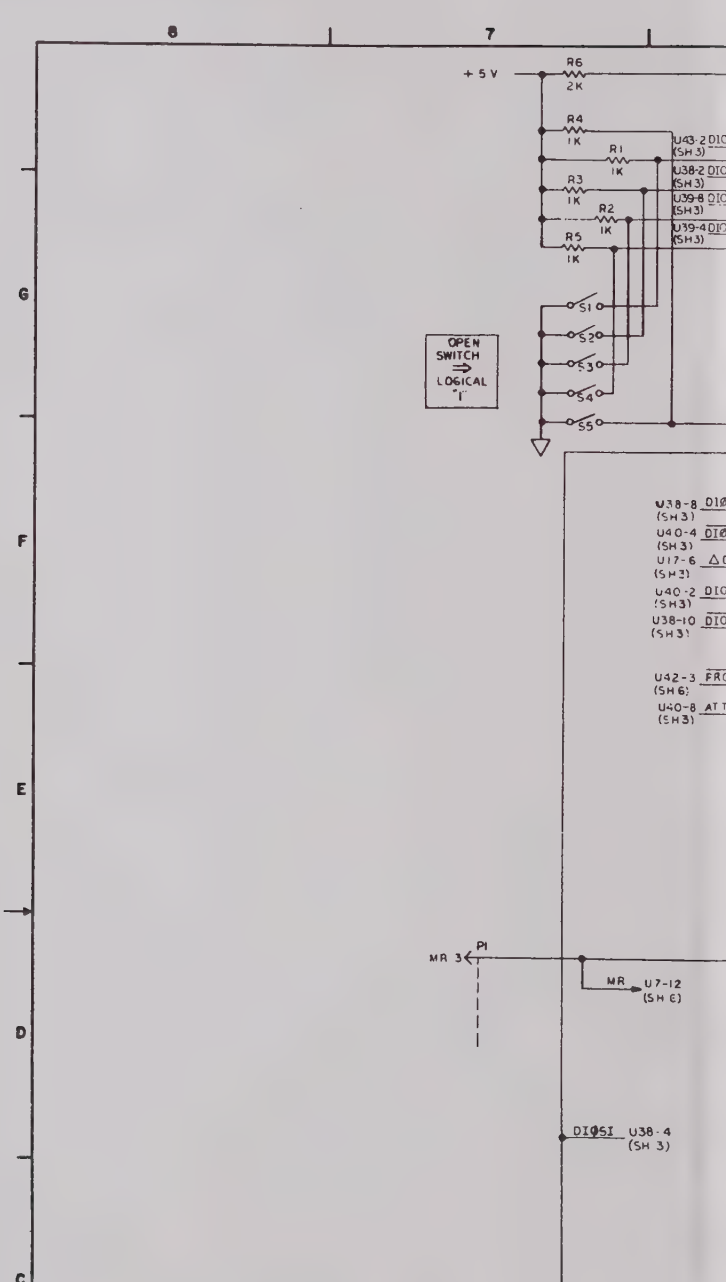


LISTEN HANDSHAKE SEQUENCE

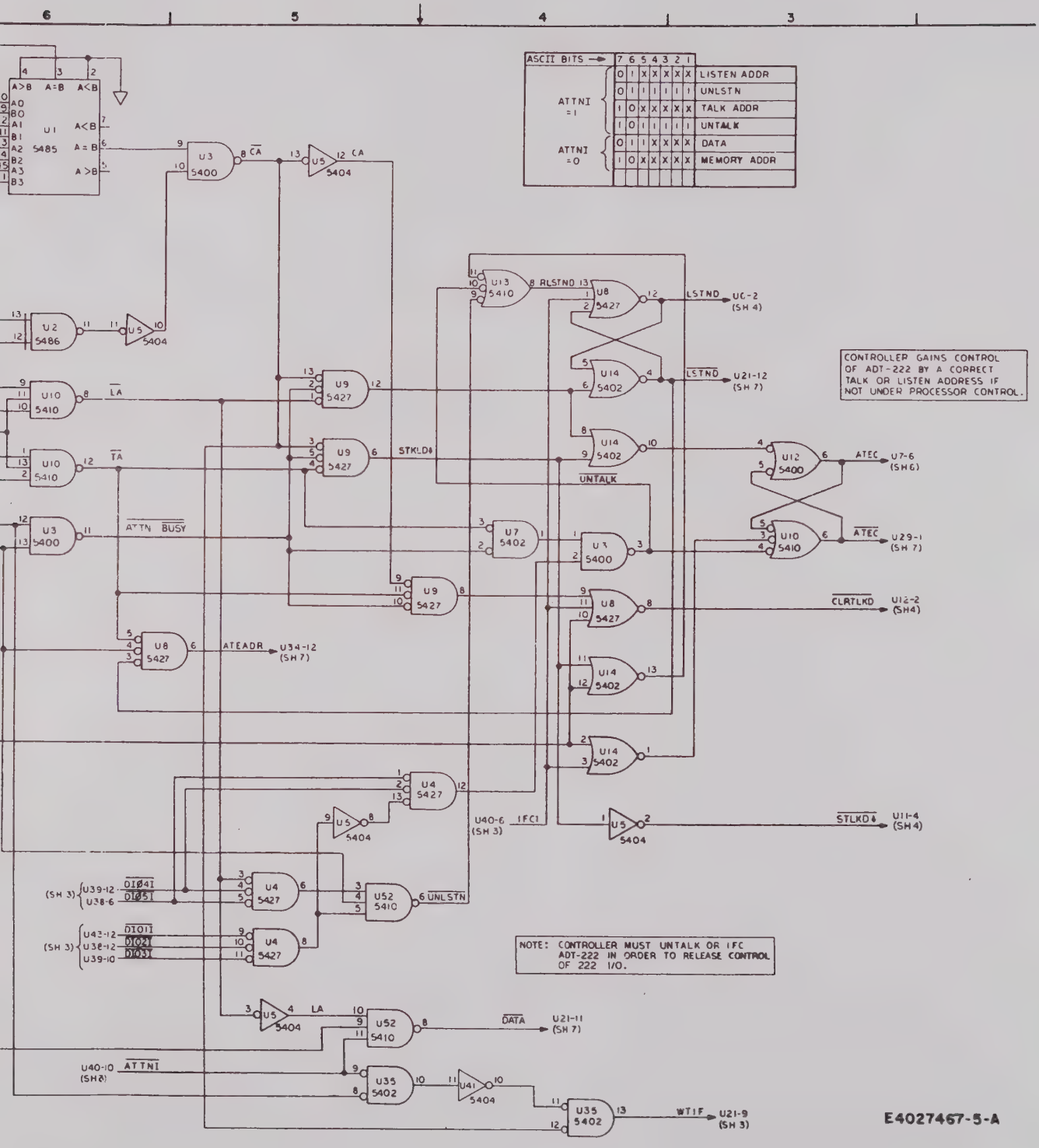


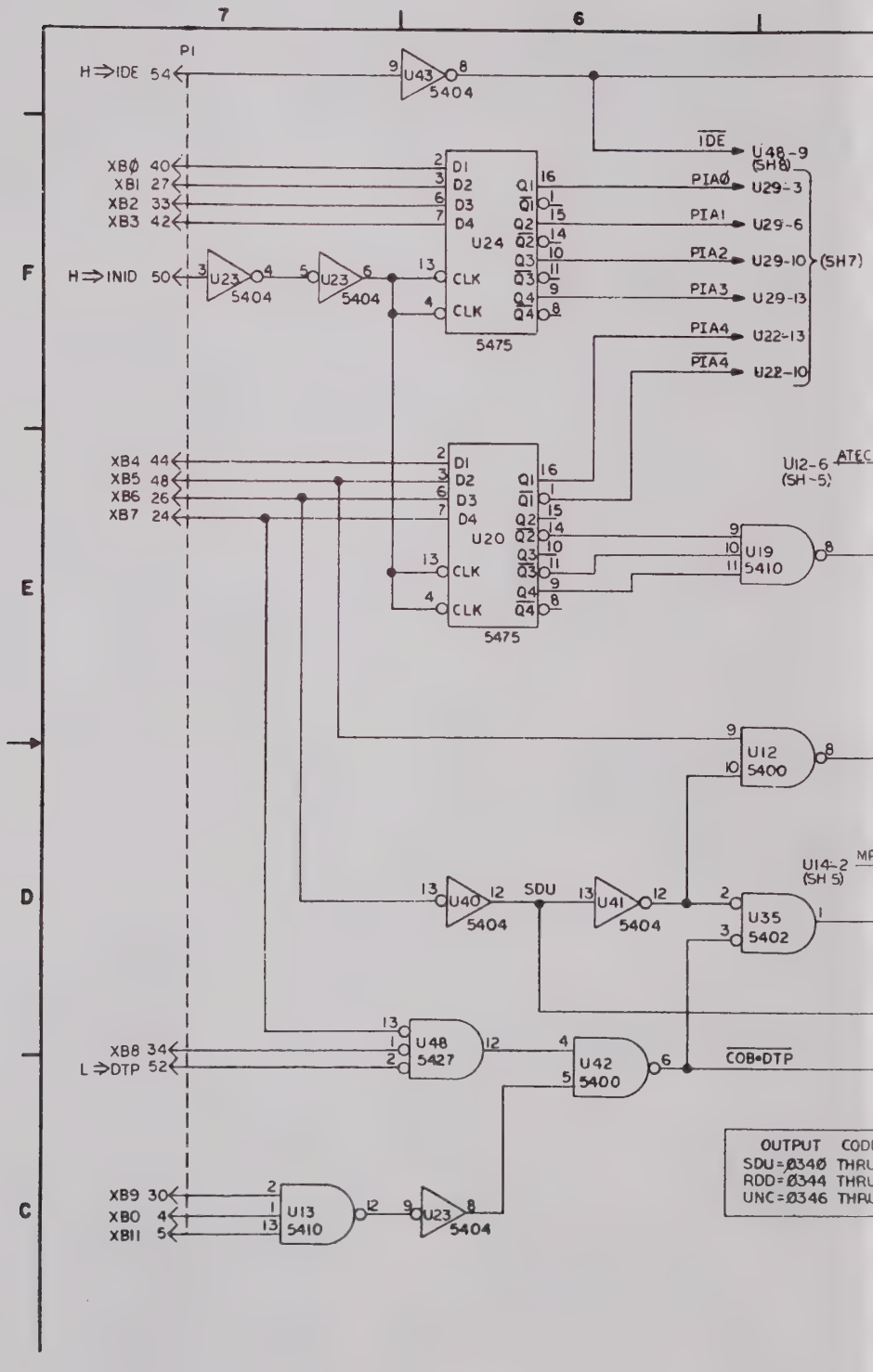
TALK HANDSHAKE SEQUENCE

E4027467-4-E

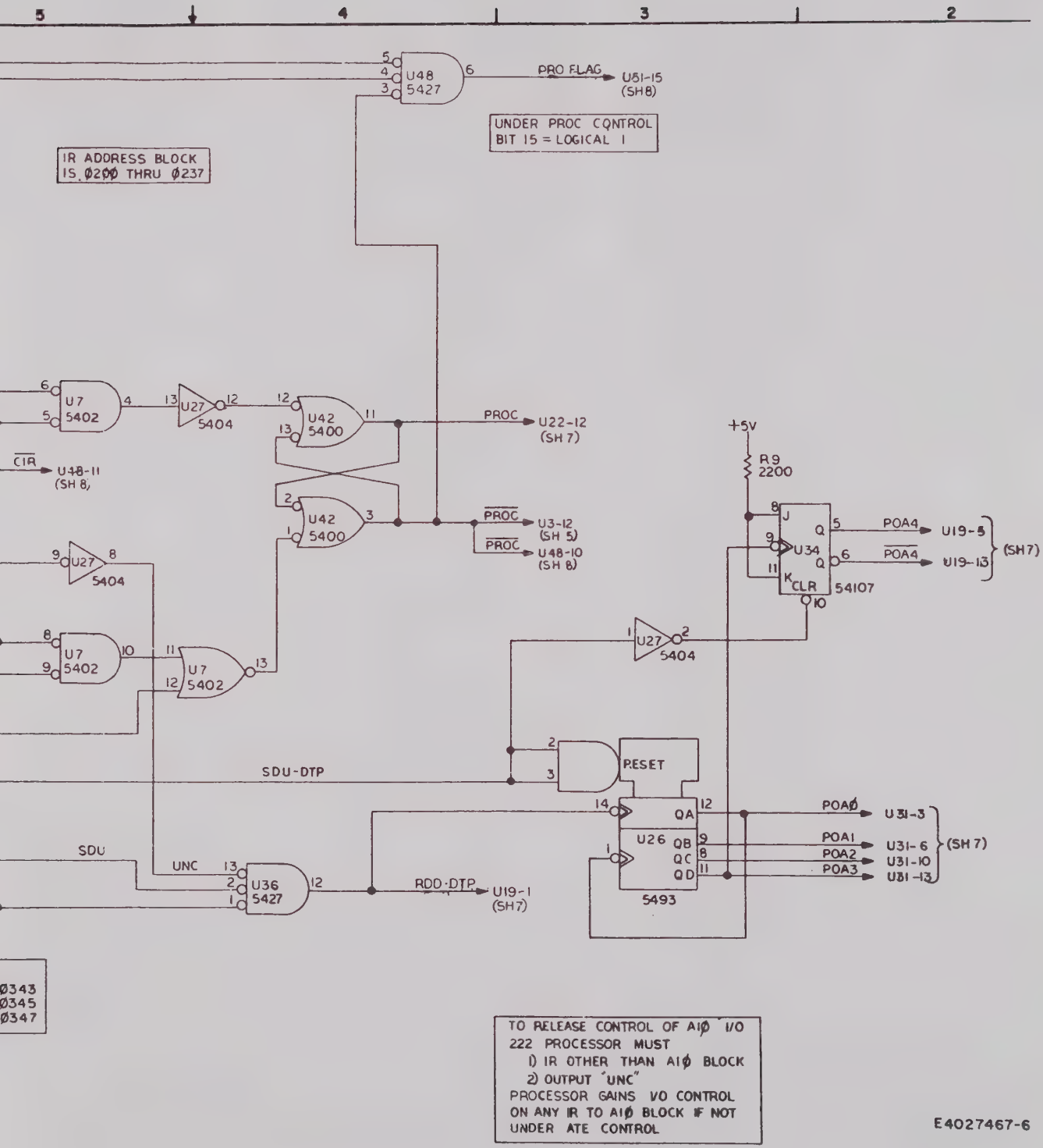


ASCII Interface Card A10
Schematic
Figure 3-6 (Sheet 5)

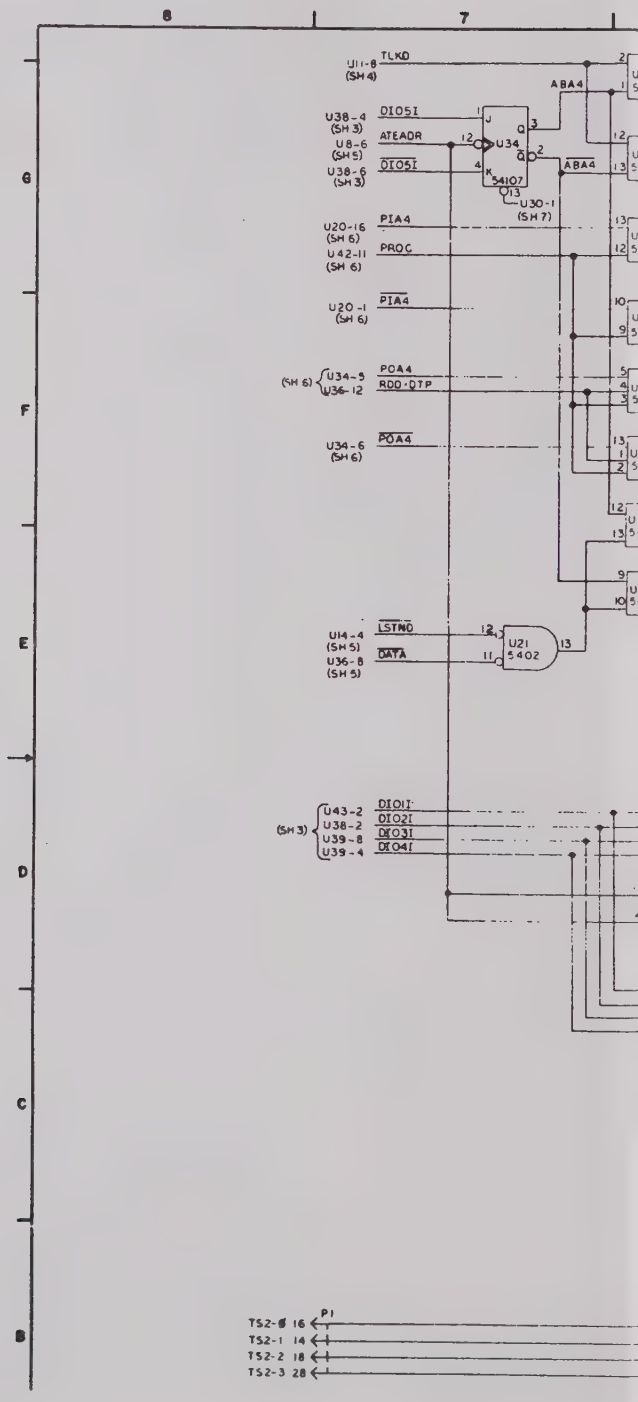

6
5
4
3
ASCII BITS → 7 6 5 4 3 2 1
ATTNI =1
0 ! X X X X X LISTEN ADDR
0 1 1 1 1 1 1 UNLSTN
1 0 X X X X X TALK ADDR
1 0 1 1 1 1 1 UNTALK
ATTNI =0
0 1 1 X X X X DATA
1 0 X X X X X MEMORY ADDR
U1 5485
U2 5486
U3 5400
U4 5427
U5 5404
U7 5402
U8 5427
U9 5427
U10 5410
U12 5400
U13 5410
U14 5402
U35 5402
U41 5404
U52 5410
CA
LA
TA
ATTN BUSY
8 RLSTND
LSTND
UC-2 (SH 4)
U21-12 (SH 7)
STKLD0
UNTALK
ATEC
U7-6 (SH6)
U29-1 (SH 7)
CLRTLKD
U12-2 (SH4)
ATEADR
U34-12 (SH 7)
U40-6 IFC1 (SH 3)
STLKD0
U11-4 (SH4)
(SH 3) U39-12 DI041 U38-6 DI051
(SH 3) U43-12 DI011 U38-12 DI021 U39-10 DI031
UNLSTN
DATA
U21-11 (SH 7)
U40-10 (SH8) ATTNI
WTIF
U21-9 (SH 3)
CONTROLLER GAINS CONTROL OF ADT-222 BY A CORRECT TALK OR LISTEN ADDRESS IF NOT UNDER PROCESSOR CONTROL.
NOTE: CONTROLLER MUST UNTALK OR IFC ADT-222 IN ORDER TO RELEASE CONTROL OF 222 I/O.
E4027467-5-A



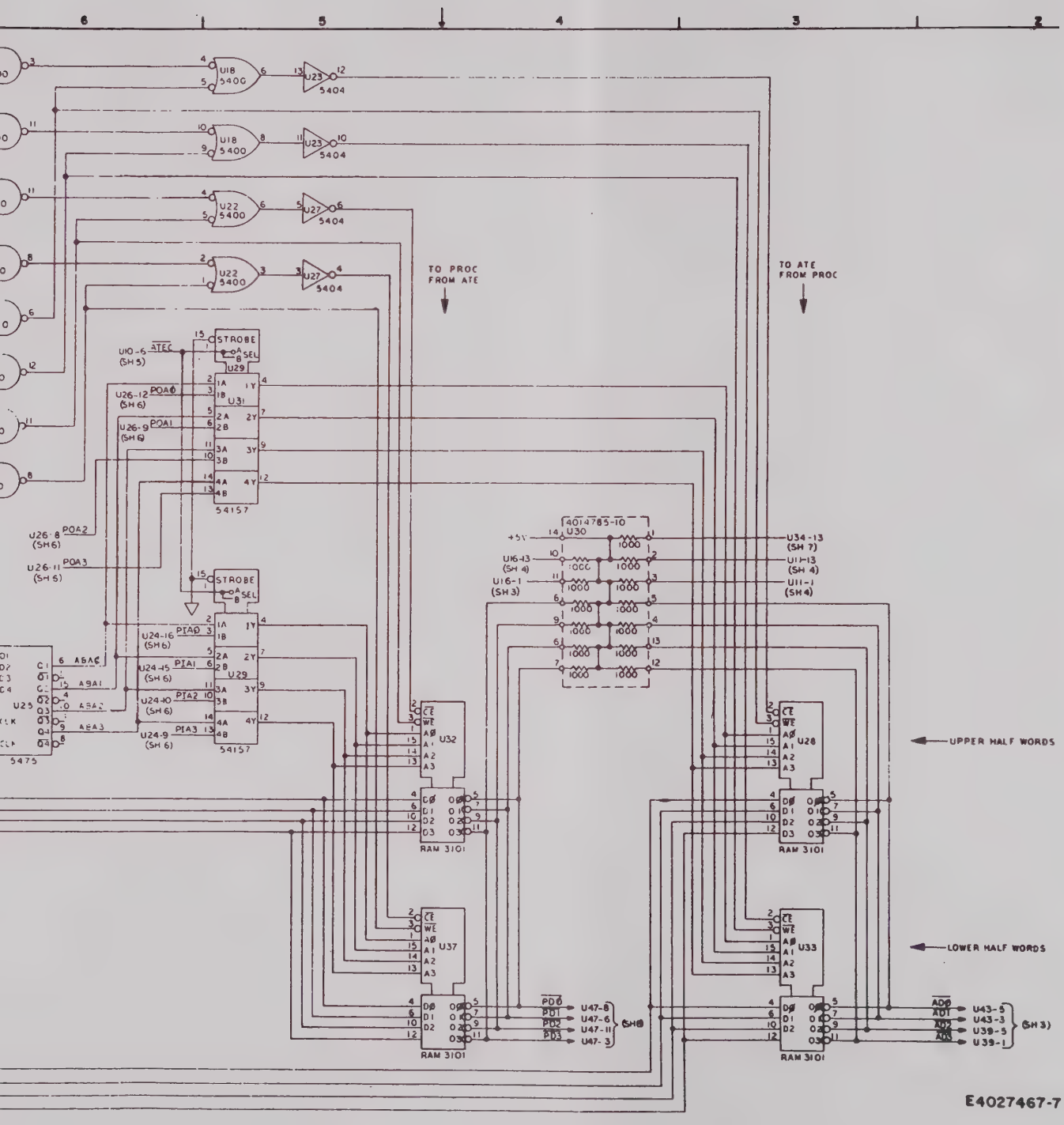
ASCII Interface Card A10
Schematic
Figure 3-6 (Sheet 6)

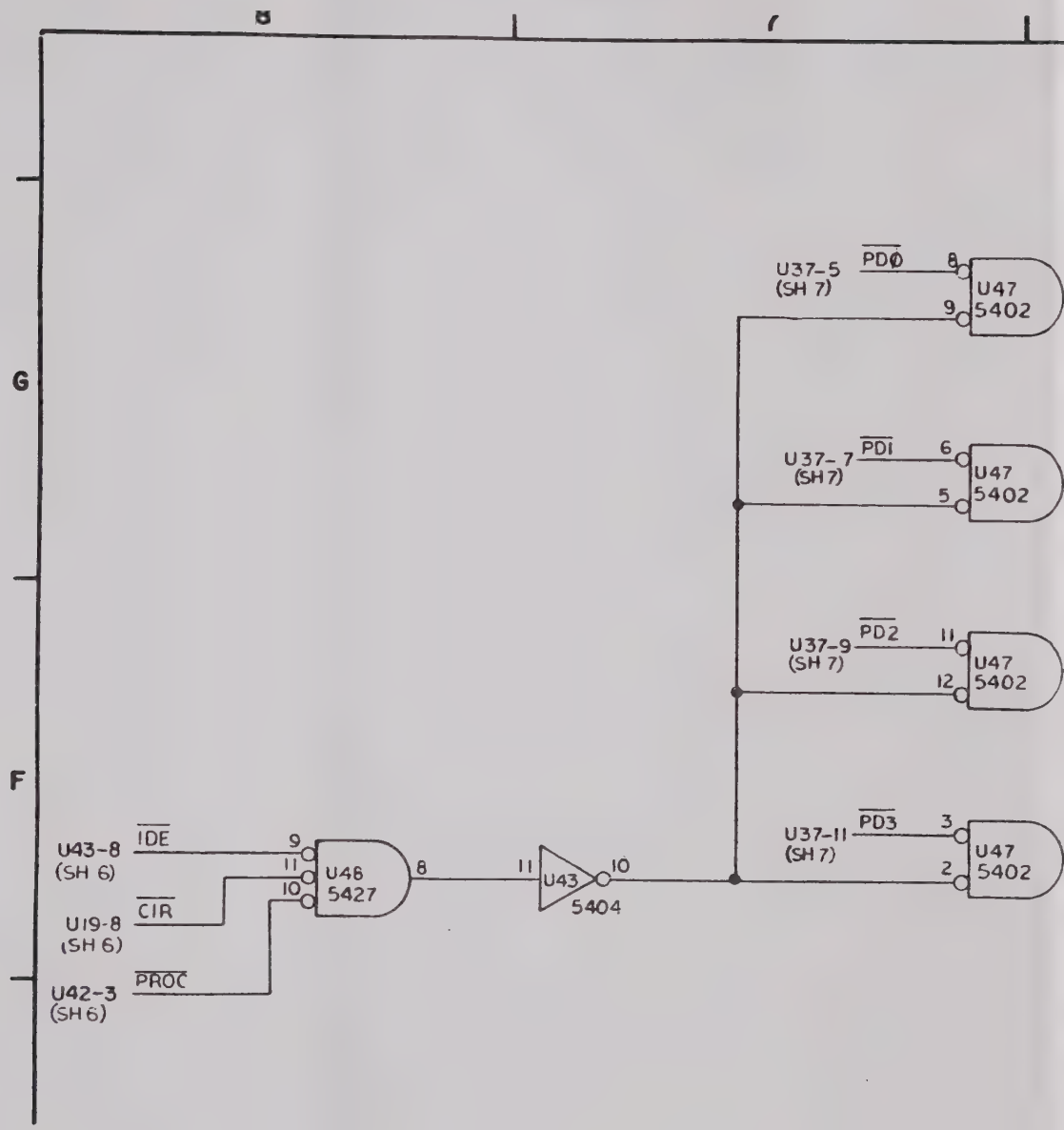

5
4
3
2
U48
5427
PRO FLAG
U31-15
(SH8)
UNDER PROC CONTROL
BIT 15 = LOGICAL 1
IR ADDRESS BLOCK
IS Ø200 THRU Ø237
U7
5402
U27
5404
U42
5400
PROC
U22-12
(SH 7)
CIR
U48-11
(SH 8)
PROC
U3-12
(SH 5)
PROC
U48-10
(SH 8)
+5V
R9
2200
U34
54107
POA4
U19-5
POA4
U19-13
(SH7)
SDU-DTP
RESET
SDU
UNC
U36
5427
RDD·DTP
U19-1
(SH7)
U26
5493
QA
QB
QC
QD
POAØ
POA1
POA2
POA3
U31-3
U31-6
U31-10
U31-13
(SH 7)
Ø343
Ø345
Ø347
TO RELEASE CONTROL OF AIØ I/O
222 PROCESSOR MUST
1) IR OTHER THAN AIØ BLOCK
2) OUTPUT "UNC"
PROCESSOR GAINS I/O CONTROL
ON ANY IR TO AIØ BLOCK IF NOT
UNDER ATE CONTROL
E4027467-6

-5
16
81

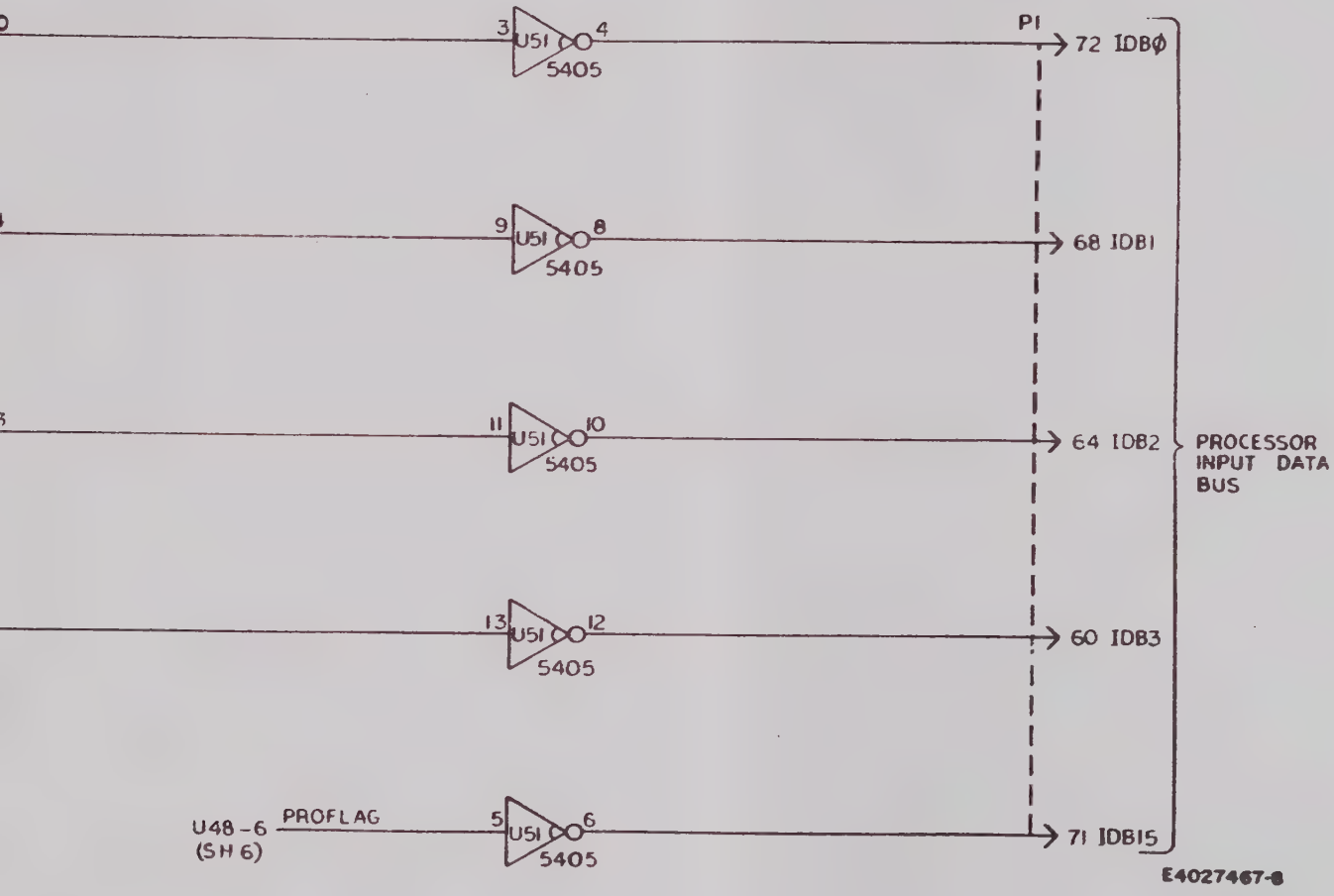


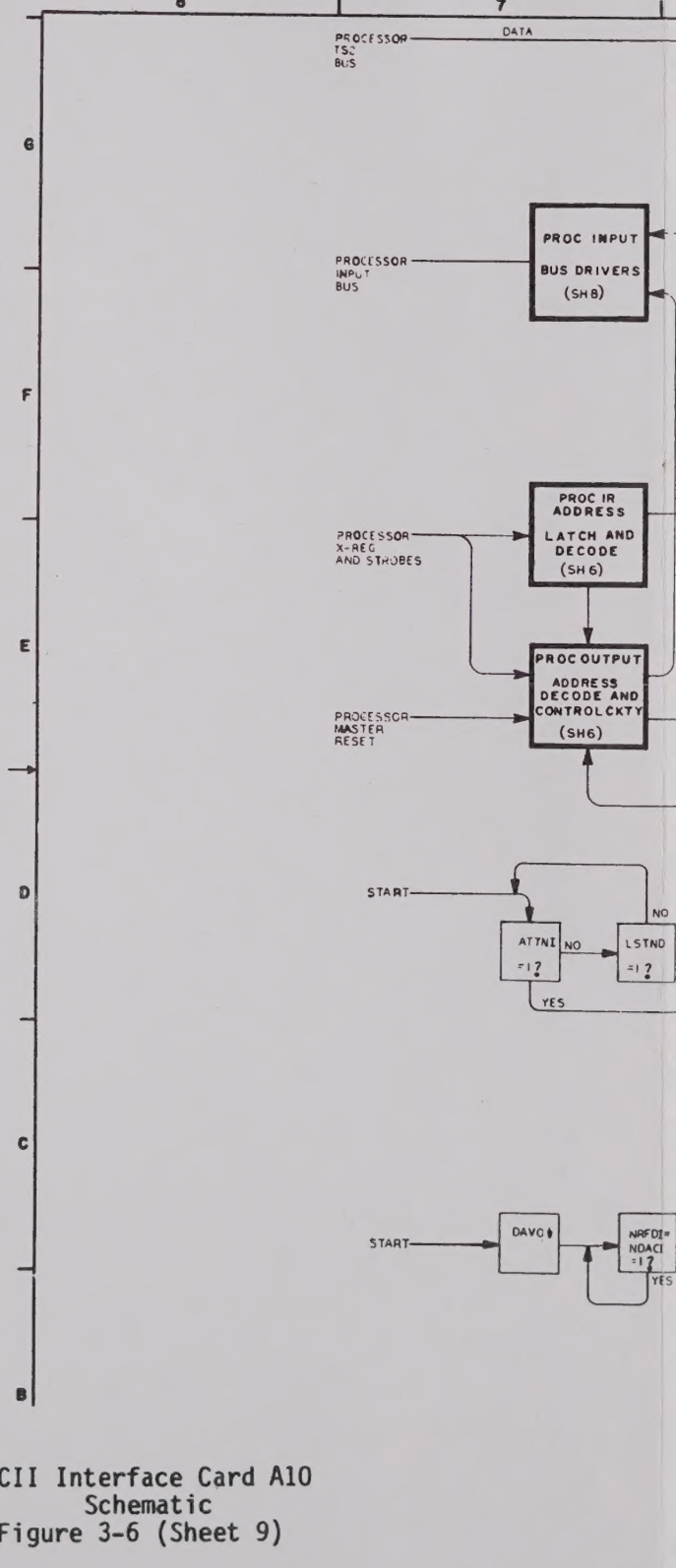
ASCII Interface Card A10
Schematic
Figure 3-6 (Sheet 7)


6
5
4
3
2
U18 5400
U23 5404
U22 5400
U27 5404
TO PROC FROM ATE
TO ATE FROM PROC
STROBE
U29
U31
54157
U30
401-4785-10
U32
U28
U37
U33
RAM 3101
UPPER HALF WORDS
LOWER HALF WORDS
U47-9
U47-6
U47-11
U47-3
U43-5
U43-3
U39-5
U39-1
E4027467-7

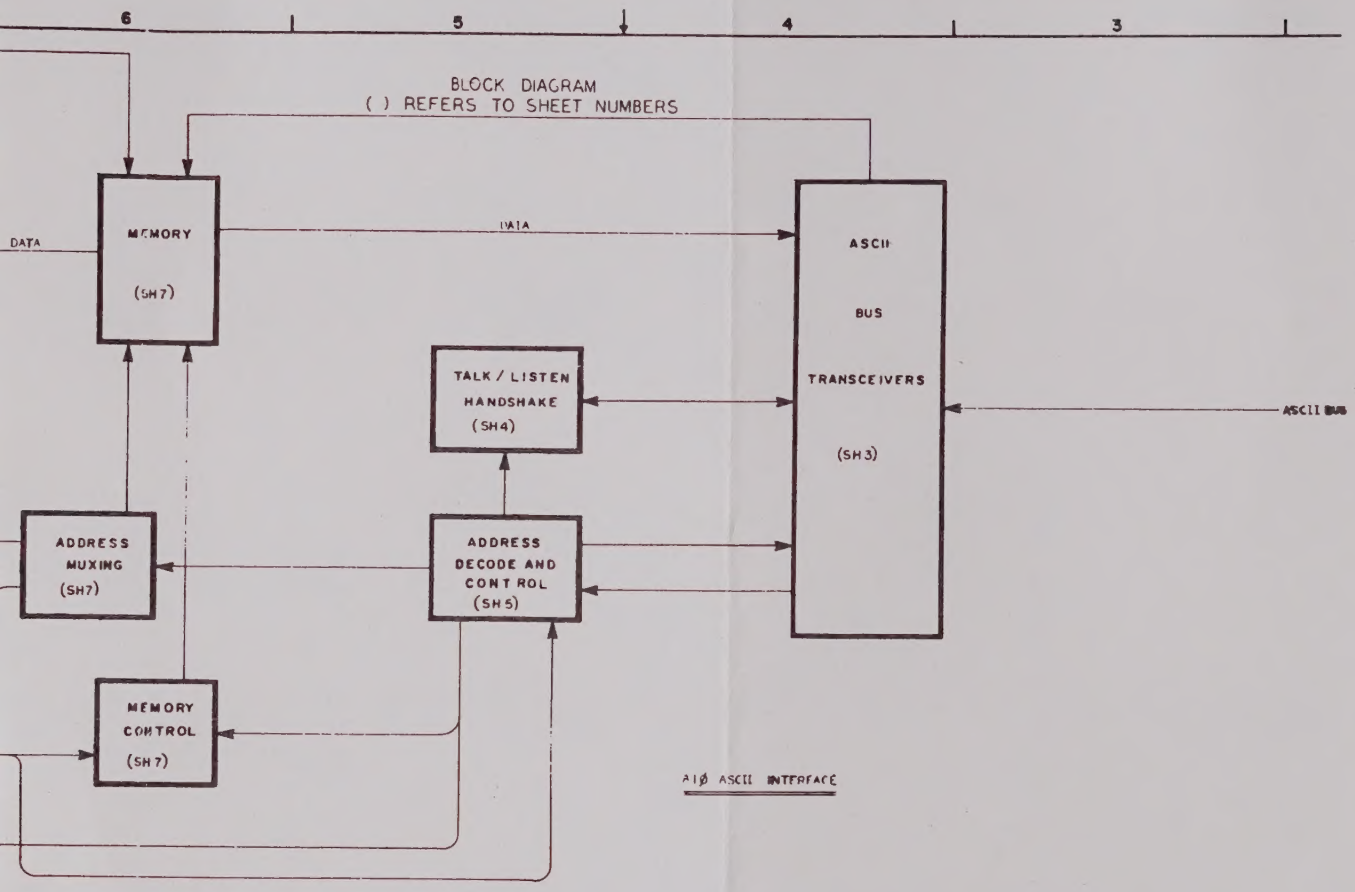


ASCII Interface Card A10
Schematic
Figure 3-6 (Sheet 8)

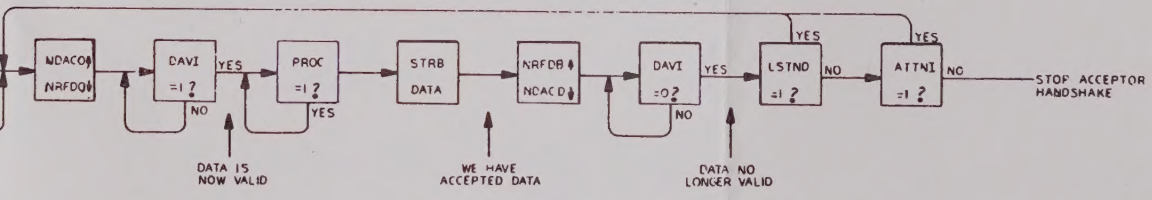

3
U51
4
5405
P1
72 IDBØ
9
U51
8
5405
68 IDB1
11
U51
10
5405
64 IDB2
PROCESSOR INPUT DATA BUS
13
U51
12
5405
60 IDB3
U48-6 (SH 6)
PROFLAG
5
U51
6
5405
71 IDB15
E4027467-8



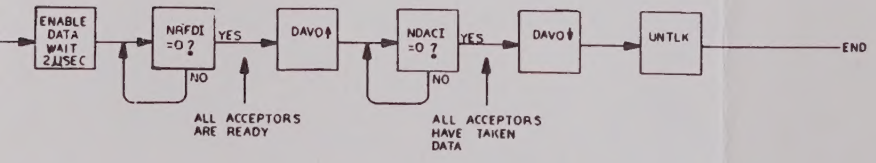
ASCII Interface Card A10
Schematic
Figure 3-6 (Sheet 9)



A1Ø ASCII INTERFACE



LISTENER HANDSHAKE FLOW CHART



E4027467-9

TALKER HANDSHAKE FLOW CHART

www.manualsplus.com
1037044

89867